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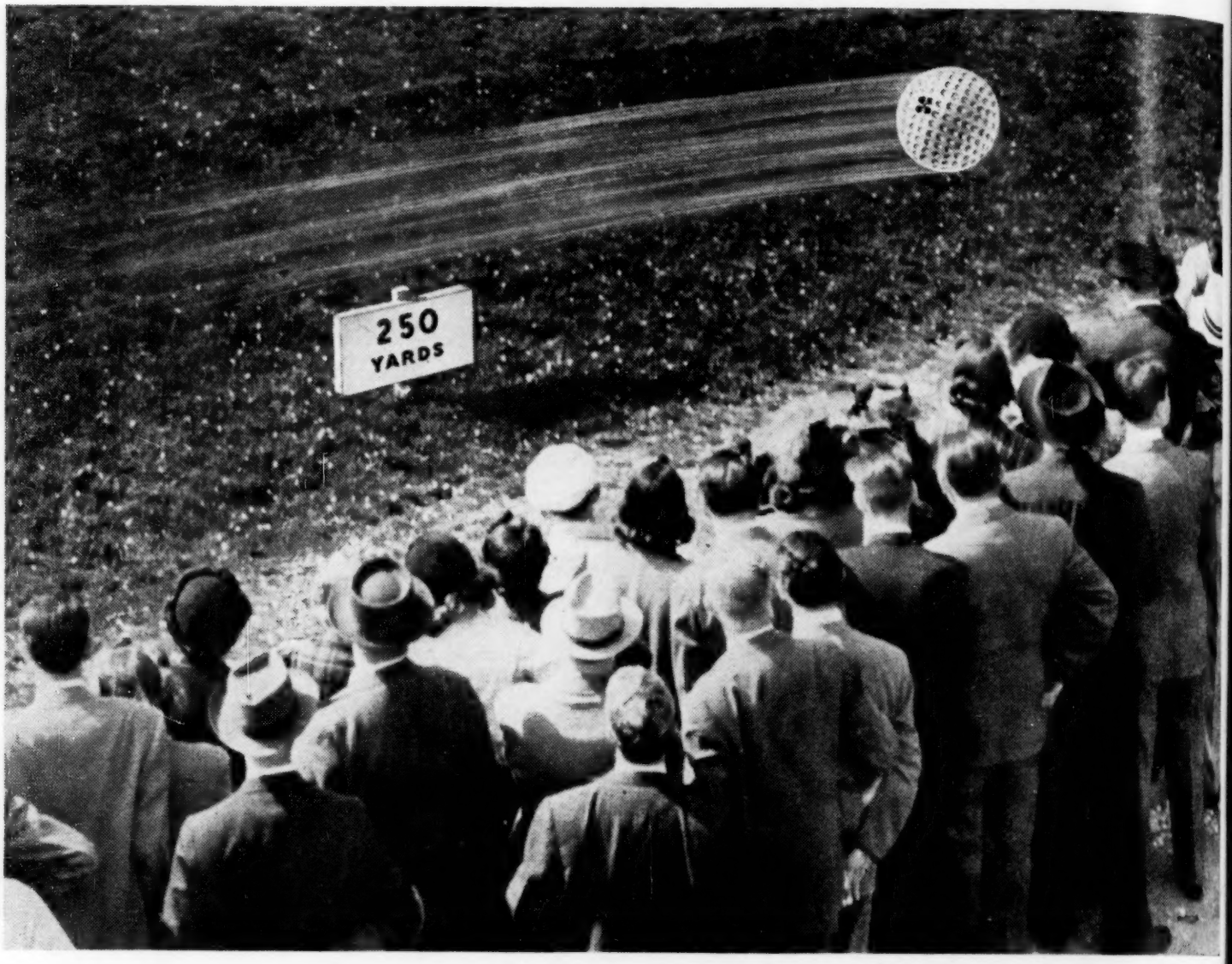

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Growth and Aging Problems in Agriculture

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AGRICULTURE IS BASED on the phenomena of growth and development. The aims and attitudes of academic agriculturists, however, differ somewhat from those of academic biologists. For instance, the agriculturist must work for predetermined objectives which are essentially to grow or to produce bigger and better agricultural crops of plants, animals, and such of their products as eggs, milk, wool, and muscular work. The only crop that academic biologists are expected to produce is good "papers," with no limitation on objectives.

The agriculturist, moreover, has to contend with a thousand uncontrollable or uncontrolled factors—reproductive, hereditary, nutritional, climatic and ecological, engineering, social-economic, and so on—which influence his productive objectives.

Then, too, the agricultural investigator has to solve special financial and methodological problems not encountered by the academic biologist. For instance, the financial costs and experimental methods of investigating a cow with its fabulous stomachs and huge consumption of roughage are of a very different order than those of investigating a rat with a simple stomach or an *obelia* in sea water. Likewise, the problem of investigating large and densely populated fields of plants subject to the vagaries of weather, insects, infections, and other pests is of a different order than that of investigating a few plants under the controlled conditions of a greenhouse laboratory.

Specific Growth Problems

It is important to remember that the agriculturist defines "growth" not as "developmental biosynthesis" but as the production of beef steaks and pork chops, milk and eggs, beans and potatoes, peaches and tomatoes, wool and cotton, flowers, race horses, Easter rabbits, Christmas trees, and so on.

The usual market (slaughter) weight of pigs is 225 pounds. The unimproved pig may require 12 months to attain this weight at a feed cost of, perhaps, 800 pounds per 100 pounds gain in body weight. But some pigs may attain this weight in 6 months at a feed cost of but 400 pounds per 100 pounds gain. Moreover, the flesh of the rapidly growing animal is more tender than that of the slowly growing one.

A major problem in agriculture is to develop such rapidly and efficiently growing animals that transmit consistently these desirable characteristics to their progeny. Unfortunately, only a few of the rapidly growing pigs produce rapidly growing progeny, and these few can be detected by progeny tests alone. But by the time adequate progeny tests are completed, the original stock is usually no longer available or has become infertile or impotent. This calls attention to the aging problem, the importance of learning how to delay it and how to utilize fully proved, aged animals, especially for reproductive purposes. To overcome some of the difficulties of utilizing fully the few desirable progeny-tested animals, agriculturists developed satisfactory methods for artificial insemination. This enables the utilization of one sire for 50 to 100 times as many females as by the natural method. A single ejaculate, for example, may provide, if necessary, enough semen for 300 cows (Salisbury), and 500 cows can easily be bred to one bull per month by artificial insemination. Over 250,000 dairy cows in the United States were bred this way in 1945. Old animals may, perhaps, be "rejuvenated" temporarily by certain hormones and/or other catalysts and by nutrients. The involved ideas are not new in agriculture, folklore, or fiction, but their wide practical application is new. And the agriculturist—especially in Missouri—usually believes that knowledge is of value only in so far as it is applied for productive purposes.

Here is an agriculturally practical example of "rejuvenation." About 1924 F. A. E. Crew reported dramatically that he "rejuvenated aged fowls (5 to 8 years) through thyroid medication." The "birds became rejuvenated, looking fresh . . . quickly started to produce eggs at a faster rate." Only recently, however, has C. W. Turner, of the Missouri Station, ap-

Presented at the 1946 Symposium of the Society for the Study of Development and Growth, held at the Rhode Island State College, Kingston, 27–30 August.

plied this medication on a large scale to fowls, confirming Crew's observation. Five-year-old birds fed thyroactive protein produced approximately 30 per cent more eggs than control birds. Berliner and Warbritton, and Bogart and Mayer, of the Missouri Station, also reported favorable results of thyroxine administration on the fertility of old rams and on fertility during the period of "summer sterility" associated with hot weather.

Another example is the rejuvenating effect of topical applications of estrogens on senile genital mucous membranes and even on skin (M. A. Goldziehr, 1946). C. W. Turner is administering estrogens to fowls in the attempt to prevent the deterioration of their oviducts at the end of the laying season.

Returning to the problems of rate and efficiency of growth, what was said about growth-rate differences in pigs holds true for other farm animals and their products, as illustrated by the following examples.

The usual market (slaughter) weight of beef steers is 900 pounds. Unimproved cattle may attain this weight in two years at a feed cost of perhaps 800 pounds TDN per 100 pounds live weight, whereas many individual animals attain it in one year at a feed cost of perhaps 400 pounds TDN per 100 pounds live weight. Moreover, as in pigs, the flesh of the rapidly growing animals is more tender. Here again, but few individuals transmit their rapid-growth characters consistently, and these rare individuals can at present be found by progeny tests alone. By the time the progeny tests are completed the original animals are likely to be unavailable.

An unimproved cow may produce perhaps 1,000 pounds of milk per year, but there are cows producing 42,000 pounds (average of 115 pounds a day). Although such cows are rare, they demonstrate the potentialities of cattle, in that 40 or 50 quarts of milk may be produced where one quart was produced previously.[1]

An unimproved fowl may lay some 30 eggs a year beginning at 1 year of age. On the other hand, there are rare chickens that begin laying at 5½ months of age and produce 360 eggs the first year.[2] These birds demonstrate the plasticity and productive range of farm animals and the possibility of producing a dozen eggs where one was produced before.

The most publicized although less dramatic increase was achieved in corn production by utilizing mostly the phenomenon of the so-called hybrid vigor, especially with regard to resistance to unfavorable temperatures and to disease. The range of increase in yield by the use of hybrid seed varies with climatic and soil conditions. The average increase in production is only 25 per cent, but the absolute increase on a $3,000,000,000 crop is huge. Greater yield, earlier maturity, and resistance to diseases (wilt, mildew, smut, smudge, blotch, etc.) were obtained in many plants by similar breeding.

Among animals, the phenomenon of hybrid vigor is best known in the mule, superior to either mare or jackass for hard labor in hot climates. Resistance to heat is also shown in crosses between certain breeds of European beef cattle (Aberdeen Angus) and Indian cattle (Guzerat, Brahman), and also in crosses with African cattle (Africander). Moreover, the weaning age, meat tenderness, and dressing percentages appear to be higher in the crosses. Resistance to cold and to infections may perhaps be developed similarly by appropriate breeding.

Attempts are being made to utilize this phenomenon of hybrid vigor in the breeding of dairy cattle and poultry. Crosses of Jersey and West Indies cattle are said to be more resistant to heat than the pure Jersey. Crosses between European breeds, such as Red Danish and Jerseys, Holsteins, or Guernseys, are said to give satisfactory results (O. E. Reed). Purebred breeders, however, object strenuously to crossbreeding.

Individual differences in rates of growth and fattening are common in many species, including mice and men. Physicians attribute them in man to differences in food consumption in relation to muscular activity. This is a thermodynamically reasonable inference. But what causes differences in food consumption in relation to muscular activity?

There is a strain of mice that shows an unusual tendency to rapid fattening. This is attributed to a certain "yellow gene." But how does this gene accelerate fattening? An insight into this situation might perhaps be furnished by energy balance experiments and by assays of hormones and other suspected catalysts and nutrients as already noted.

The agriculturist usually conducts investigations not on the ultimate component factors but on complexes such as the complex "growth rate," "milk production," "egg production," "wool production," "racing ability," or "work ability" (in horses or mules), and so on. Maybe this is not a correct method; perhaps, as suggested for the "yellow gene" mice, the agriculturist should learn to test each animal for the level of each of the catalysts suspected in limiting growth and other productive rates, such as the hormones of the pituitary, thyroids, adrenals, gonads, such groups

[1] The dairy cows in the United States, Great Britain, Canada, and New Zealand produce, on the average, 4,500 pounds of milk a year. The dairy cattle in Denmark produce, on the average, about 7,500 pounds. The Dairy-Herd Improvement Association cattle (in the U.S.A.) currently produce from 8,000 to 10,000 pounds a year.

[2] The average production in Missouri in 1945 was 152 eggs. The farm demonstration flocks averaged 178 eggs, and the high individual record was 354 eggs under R.O.P. supervision. Thirty years ago the average Missouri hen laid about 80 eggs per year; 20 years ago the average was about 100 eggs. The greatest increase in average production has been in the past five or six years.

as sulfhydryl enzymes, and such tests as basal metabolism and configuration of electromagnetic fields (Burr), just as the nutritionist analyzes foods or feeds for their vitamins, amino acids, and minerals in relation to their limiting effect on growth rate and other productive processes. Here is a capital problem worthy of the efforts of the best academic as well as agricultural investigators.

There is indeed evidence that rates of growth, milk production, and egg production may often be accelerated, for example, by administration of thyroid hormone or thyroactive protein. On the other hand, reducing the thyroxine level by feeding goitrogenic substances, such as thiouracil, decreased the growth rate but increased the fattening rate. A female sex hormone was observed to effect growth and fattening rates, as does thiouracil (L. W. Taylor), although by a different physiological mechanism. Male sex hormone, on the other hand, tends to increase growth rate rather than to increase fattening rate. These results point to the definite possibility that the hormonal balance is a major factor in the control of productive and reproductive rates.

The body chemistry, especially its catalytic components, will undoubtedly receive ever greater attention in its bearing on rates of agriculturally productive processes and also on neoplastic growth.

The outstanding needs in agriculture are yardsticks for measuring productive levels and methods for predicting productive potentialities in young animals. Just as methods have been developed for early recognition of intellectually gifted children, so methods must be developed for *early* recognition of productive capacities in farm animals. Rapidity of growth and fattening may well be correlated with the levels of some catalysts, nutrients, metabolic rate, electrical configuration, and so on. These levels may perhaps in turn be used to predict future performance in the young without resorting to the laborious progeny testing.

The Rate of Aging

Next to growth rate, the aging rate is the most important factor in the over-all economy of animal production. Dairy cattle, for example, do not pay for themselves in milk and calves until they are about four years old, and the longer thereafter they maintain a satisfactory yield in milk and calves, the greater the clear profit on the growth investment. The same holds true for poultry, for work stock (horses and mules), and for all breeding stock, especially those that are progeny tested.

Unfortunately, the rate of growth, and therefore the rate of maturing, is correlated with the rate of aging: the earlier an animal matures, the earlier it grows old and the earlier it dies. This correlation could be predicted from C. S. Minot's classic generalization of 1889, that "retardation of growth is old age." It was also demonstrated by the caloric underfeeding experiments of Osborne and Mendel (1914–15) and especially by those of McCay and Maynard (1941). About 1940 R. Schoenheimer, employing isotopes of hydrogen and nitrogen as tracers, observed that there is continuous renewal of body nitrogen. But as this metabolic interchange occurs at an ever-decreasing rate with increasing age, the *proportion* of young tissue declines with increasing age. This decrease in young tissue or increase in old tissue constitutes the basic aging process reflected by progressive dehydration, reduction in chemical reactivity and elasticity, and quantitatively measurable in man by the decline in accommodation range of the eye. The latter is most rapid at the earliest ages on which data are available. This harmonizes with Minot's theory of aging and also with the theory that body tissues are colloids and, like other colloids, age with time.

The problem of retarding the aging rate—the search for the fountain of youth—is, of course, as old as human thought. It has already been noted that delay in aging of rats was accomplished by caloric underfeeding. Mention may be made of similar earlier experiments by Waters, Trowbridge, Moulton, Haigh, and associates on steers at the University of Missouri (1919), by Childs on planarian (1915), and the recent ones on rats by Carlson and Holtzel (1946). Overeating on calories, particularly if derived from fat, is known to reduce life expectancy.

With regard to hormonal methods of control of aging, it has also been noted that thyroxine or thyroprotein appears to "rejuvenate" old fowls as measured by egg production and rams as measured by fertility.

We have defined aging as decrease in metabolic exchange, decrease in the replacement rate of old "building stones" for new ones. Would thyroxine, for example, which apparently accelerates such a metabolic exchange, delay or accelerate the aging rate—that is, provided it was administered at certain optimal levels? Similar questions might be asked about other hormones. It is not original to suggest that sex and other hormones may have "rejuvenating" effects when administered at certain levels, but it is new to investigate this idea seriously and to apply the results to increase agricultural production.

The Effects of Environmental Temperature

The internal physicochemical environment of the body, including its hormone and enzyme levels and nutrients, is dependent not alone on its heredity and nutrient supply but also on the physical environment,

including temperature, light, humidity, air movement, barometric pressure, and so on. This is shown, for example, by the 30-per cent decrease in blood calcium level in fowls when the environmental temperature is increased from 70° to 90° F. (Conrad, 1939), a common temperature fluctuation, and by decrease in eggshell thickness and egg size (D. C. Warren, 1940). The rate of milk production and the level of solids in the milk, especially fat and protein, decline steadily with rising temperature above 70° F. The growth rate in all domestic animals declines with rising temperature above 70° F., and, of course, muscular activity tends to decline rapidly with increasing temperature.

One basic thermal fact relating productivity with environmental temperature is that even unproductive living involves a large energy expense. Most of this energy is dissipated in the form of heat. The production of milk, eggs, body tissue (growth), and muscular work is associated with the production of huge quantities of heat, partly because there is a work, and therefore a heat, component in these activities, but mostly because of the heat increment of feeding, the so-called specific dynamic effect, which is the heat production associated with the intermediate chemical reactions in the body, the transformation, for example, of hay into body tissue or milk, and the heat production associated with the excretion of the waste products of such reactions.

A second basic fact is that environmental temperature affects profoundly the endocrine activities of the adrenals, gonads, and especially the thyroids. E. W. Dempsey and E. B. Astwood reported in 1943 that at 1° C. 100-gram rats produced 9.5 μg. thyroxine per day; at 25° C., 5.2 μg.; and at 35° C., 1.7 μg. C. W. Turner recently observed that fowls secreted 12 μg. thyroxine (in terms of d-l thyroxine) in cold midwinter but only 8 μg. in hot midsummer, and that there was a parallelism between thyroxine and egg production. The seasonal sex activities of most animals are associated with the day-to-night ratio (light), but temperature *per se* is also an important influencing factor. Most animals and plants are photoperiodic, but many are thermoperiodic. Photoperiodism and thermoperiodism may or may not be associated.

The long-range effect of high temperature is to reduce the body size (since the smaller the body, the greater the surface per unit weight and heat dissipated by way of the surface); to modify the body build so as to give the largest surface area; to develop sweat glands, since sweat vaporization is the most effective method for cooling the body; to reduce the amount and quality of fur; to reduce the amount of insulating subcutaneous fat; to develop protective coloration against light and therefore, in part, against heat; and especially to reduce heat production by reducing the level of muscular activity and of food intake. The apparent poise of the southern gentleman and the laziness of the "white trash" as well as of the dark are not products of race but of homeostatic mechanisms for protection against over-heating. The best way to keep cool in hot weather is to take it easy and eat sparingly, which are very unfavorable factors for high production. As has been mentioned, high temperature leads to depression of the activity of the thyroid and other endocrines. These combinations of circumstances lead to depression of the productive levels in hot and humid climates. The seasonal rhythms in fur production, subcutaneous fat deposition, sex activity, migratory activities, and muscular and other activities are dramatic illustrations of adaptation to environmental temperature and light. The mechanisms whereby these effects are accomplished are under investigation but not to the extent that they deserve to be.

Most of the careful investigations on the effects of the temperature complex on the reactions of organisms have been made on simple biochemical systems *in vitro* and on small poikilotherms which can be handled inexpensively. The sheer size of large farm animals places serious obstacles in the path of their investigation, so that but little scientific information is available on the effects of the temperature complex on farm livestock.

This is, evidently, a very important agricultural problem. Our best dairy cattle, for instance, evolved in equably cool maritime climates, such as Holland, Denmark, Scotland, and the Channel Islands, and their sweating mechanism—the chief cooling device in hot weather—is undeveloped. Yet they are concentrated in the Middle West and other regions subject to very high summer temperatures. The same holds true for virtually all our farm livestock. Selection of farm animals for high productive levels is not very helpful if unfavorable temperatures inhibit the realization of desirable potentialities.

The heat production is dissipated mostly by radiation at lower environmental temperatures, but as the environmental temperature rises, the function of heat dissipation by radiation, convection, and conduction is gradually taken over by moisture vaporization. Unfortunately, most farm animals do not sweat appreciably, and so the body temperature tends to rise when the environmental temperature reaches about 70° F. The animal then protects itself simply by reducing its activities. The decrease in the production of milk, eggs, body tissue, etc. with rising temperature is, then, in the nature of a homeothermic or homeostatic mechanism. It is not wholesome for nonsweating animals, or even for sweating man, to produce more heat in hot

weather than is absolutely necessary, and they generally do not.

One thinks of two methods for increasing resistance to high temperature. One is biological, by crossing, for example, nonsweating cattle originating in cool Europe with the sweating cattle originating in hot Asia; the other is engineering, involving the control of the "private climate" of the animals. Both methods need investigation.

The Need for "Normal Standards"

We have seen that many factors influence the growth rate or production rate of farm animals, plants, and certain of their products. In order to investigate quantitatively the influence of each of these factors, it is necessary to have typical or average values, so-called "normal standards," for growth and aging.

There are generally accepted yardsticks for over-all growth, especially for growth in weight, but there are none for aging. Fortunately, the agriculturist is not interested in the over-all aging process, but rather in the aging of special functions, such as milk, egg, and wool production, fertility, and muscular-work ability. With the exception of work ability, the above criteria of aging are measurable, and the problem of muscular-work ability (in horses, mules, and asses) is at present under active investigation.

"Standards" for growth in weight, milk production, and egg production are available, but they are not without serious ambiguities. For instance, present-day white rats are larger and approach mature size at a different rate than those of 25 years ago because of selection and differences in methods of feeding and housing. The same holds true for other categories of animals. In brief, the standards, reference bases, and measuring rods themselves change with time and circumstance. Nonetheless, they are valuable for furnishing orienting backgrounds.

Standards are also needed for relative (allometric or heterogonic) growth—the relation of part to part and part to whole. For instance, the commercial value of a pig is not proportional to its gross weight alone but also to its dressing percentage and to the *relative* amounts of bacon, ham, loin, visceral organs, and so on. The value of a dairy cow is similarly dependent, not on its size but on the *relation* of its milk yield to size (maintenance cost). The value of a horse or mule is not dependent on its size alone but on the work it can do in relation to its size (maintenance cost); and so on with other productive processes. "Normal standards" are needed for these relations, and also an understanding of their significance.

Incidentally, one difference between a highly developed modern pig and an undeveloped one is in the bodily proportions at different ages and in the associated differences in their path of approach to the market size. J. Hammond and C. P. McMeekan (1928–40) demonstrated differences in the economy of pork and mutton production by controlling the speed of growth at different ages. This is a promising field of research on all categories of livestock.

Standards of age changes in growth efficiency (ratio of energy stored in the body to dietary energy, or feed required per 100 pounds live weight gain), and the influencing factors, are related problems of importance.

Normal standards are particularly useful if codified or generalized by rational equations—so-called "laws" of growth—having meaningful constants, constants which express quantitatively and meaningfully the productive rate and level at any given age and also represent the productive change with age.[3]

The relation between monetary profit and biologic efficiency also needs investigation. Profit depends not only on biologic efficiency of the process but also on many economic factors, such as costs of the labor, feed, housing, taxes, and other overhead expenses. For instance, two 800-pound cows producing as much milk and at the same energetic or biologic efficiency as one 1,600-pound cow are not as profitable, because the labor cost of milking, feeding, cleaning, housing, etc. is nearly twice as great for the former as for the latter. Goat, dairy cow, rat, mouse, and man produce milk at approximately the same biologic efficiency, but at quite different monetary cost.

In connection with the need for growth standards one thinks of the needs for sharply defined *biologic units*, especially units of mass and time. For instance, the basal energy and endogenous nitrogen metabolism per unit weight of a 0.05-pound (24-gram) mouse is about 20 times as great as that of a 1,200-pound cow. (The same relation probably holds true for feed consumption and milk production per unit weight.) The *biological* significance of a *physical* unit of weight is then about 20 times as great in a mouse as in a cow. Likewise, the rate of approach to mature body size is about 20 times as great in a 0.05-pound mouse as in a 1,200-pound cow. (The growth rate, k, in equa-

[3] The following equations are simple and useful for representing the three categories of growth mentioned: $Y = Ae^{kt}$ (1); $Y = A - Be^{-kt}$ (2); $Y = aX^b$ (3). Equation (1) represents the self-accelerating phase of growth prior to the major inflection of puberty in animals or flowering in plants; it may also be used for representing the rate of aging. Equation (2) represents the self-inhibiting phase of growth following the major inflection. Y is size of the animal, plant, or function at age t; k is the relative growth rate (or percentage rate when multiplied by 100) with respect to growth already made, Y, in equation (1), and with respect to growth yet to be made to reach mature size, A, in equation (2). The constant, k, in equation (2) is, then, the numerical value of the speed of approach to mature size, A; e is the base of natural logarithms. Equation (3) represents the relation of part, Y, to whole, X, and the exponent, b, is the relative increase in Y when the increase in X is 1.0. For instance, when the value of b is 0.5, it means that the part, Y, grows 50 per cent as rapidly as the whole, X.

tion (2)[3] is 0.8 for mice and 0.04 for cows.) This means that the *physiological* significance of a *physical* unit of time is about 20 times as great in the mouse as in the cow. *Physical* mass and time thus have different *physiological* significance in different species, individuals, and ages. Physical units of time are therefore ambiguous when applied to biological processes. There is need for clarification of *physiologic* units of mass and time. In the same category is the need for determining physiological equivalence of time and mass in different species of animals, so as to enable the transfer of experimental results from one species, individual, or age, to other species, individual or ages.

Summary

It appears that while the immediate objectives of the agriculturist differ from those of the academic biologist, the long-range needs for standards of growth and aging, for physiologically equivalent units of time and mass, and for knowledge of the influence and mechanisms of various internal and external factors on growth and related processes are the same for both. This suggests that these two groups of biologists should work together more closely.

Technical Papers

Cardiac Failure in Cattle on Vitamin E-free Rations as Revealed by Electrocardiograms[1]

THOR W. GULLICKSON and CHAS. E. CALVERLEY[2]

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St. Paul

During the past 8 or 10 years, in connection with an extensive study designed to determine the role of vitamin E in the nutrition and reproduction of cattle, a considerable number of the animals fed vitamin E-free rations throughout their entire lives have died suddenly and without evident cause as revealed by gross post-mortem examinations. The deaths have occurred among animals of both sexes and at ages ranging from 18 months to 5 years. The manner and suddenness of the deaths strongly suggested that the heart was involved. A variety of effects of vitamin E deficiency have been reported in different species of animals, muscular dystrophy in some form being the most common. Recently Houchin and Smith (*3*) produced muscular dystrophy in vitamin E-deficient New Zealand white rabbits 5 weeks of age. They found such animals to be highly susceptible to the action of the posterior pituitary extract, being killed by much smaller doses than were easily tolerated by controls receiving α-tocopherol. The dystrophic rabbits were, however, more resistant to normally lethal doses of cardiac glucosides. Radiographic examinations of the thorax showed the probable existence of cardiac dilatation. They concluded that the sudden death which occurs in advanced cases of muscular dystrophy is due directly to cardiac failure.

The electrocardiograph is constantly being used in the study of heart conditions in human subjects. That it can be put to similar use with the bovine has recently been shown in the comprehensive studies of Alfredson and Sykes (*1, 2, 4*) and Sykes and Moore (*5*). With these facts as a basis, beginning on November 1945 and at monthly intervals or oftener thereafter, electrocardiographs were obtained on all animals on experiment. The instrument used and methods employed were essentially the same as those of Alfredson and Sykes (*1*).

Selected recordings indicating the progressive changes that occurred in the cardiac cycle of E541 are presented in Fig. 1. This heifer is the only animal that has died since the electrocardiogram recordings were started. Her dam and sire were both raised on vitamin E-free rations and died suddenly in the same manner as their daughter. E541 was born on 8 July 1944, was bred on 19 February 1945, and calved normally on 27 November 1945, when less than 17 months old. She died suddenly on 4 April 1946.

Study of the series of electrocardiograms obtained on this animal reveals that a gradual and progressive change occurred, the later recordings showing definite indications of the presence of cardiac abnormalities. The first definite changes appear in the recordings of 21 December 1945, as shown by an increase in P–R interval, a condition which persisted throughout the remaining records. The QRS complexes in Leads II and III also were changed, the

[1] Published with the approval of the director as Paper No. 2307, Scientific Journal Series, Minnesota Agricultural Experiment Station.

[2] The authors express their sincere thanks and appreciation to Joseph F. Sykes, Bureau of Dairy Industry, U. S. Department of Agriculture, for his assistance and aid in interpreting the electrocardiograms.

otential in Lead II was reduced, and the QRS in ead III changed from an RS type to an R type, indication of axis deviation.

A clearly apparent increase in the QRS interval ppeared in the record of 19 March 1946. The QRS Lead II also changed from an RS type to an R

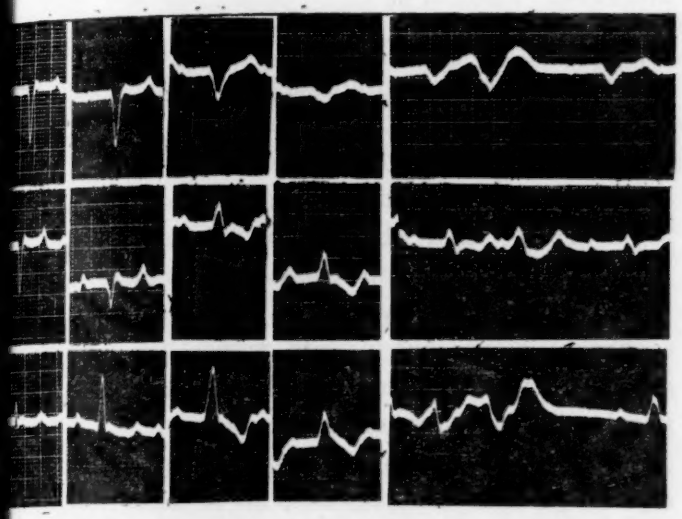

FIG. 1. Electrocardiograms of E541 on dates indicated. Leads I, II, and III, top to bottom in order.)

ype. In the record of 26 March 1946 the potential f the various deflections has decreased and remains in the subsequent recordings.

In general, the electrocardiograms obtained on this nimal appear to show a decreased functional ac- vity of the myocardium in the terminal stages of the eficiency, as indicated by the decrease in the po- ential of the deflection of the QRS complex and by e increase in duration of the P–R, QRS, and Q–T tervals. The extra systoles which are apparent in e last record indicate dissociation of atrial and entricular impulses and possibly damage to the onducting tissue. As has been stated, there also as a change in the electrical axis of the heart as e deficiency progressed.

Microscopic studies of heart sections, especially in- olving the Purkinje network of this and other nimals in the study, are being made. It can be ated, even though this work has not been completed, at definite abnormalities have been noted. Atrophy nd scarring of the cardiac muscle fibers is clearly dicated. An increase in cellular elements is noted, some instances strikingly resembling, though smaller an, the Aschoff nodules seen in human endo- arditis.

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Influence of Purified Lignin on Nitrification in Soil [1]

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The study reported here was preliminary to a more extensive study planned to investigate the effect of plowed-under crop residues on the nitrifying process in soil. The object of this preliminary study was to determine the effect of purified lignin on the nitrification of dried blood and of ammonium sulfate in soil.

It is an accepted fact that plant residues of high lignin content decompose slowly in soil because of the resistance of lignin to decay; and lignin in soil has been found to interfere with the natural process of breaking down other organic matter. In particular, lignin depresses protein decomposition. Among the authorities who may be cited in support of this contention are Waksman and Iyer (*7*), Waksman and Hutchings (*6*), and Osugi and Endo (*3*).

In the first of these references the statement is made that the action is not toxic but is an interaction between lignin and protein which results in the formation of a complex "humus nucleus" of lignin and protein. In the second reference it is stated that lignin acts as a buffer to absorb NH_3 and combines with protein to form a complex that is highly resistant to decomposition. Smith and Brown (*4*) state that lignin does not possess antiseptic property but that it does decompose very gradually; while Norman (*2*) states that isolated lignin apparently has bacteriostatic action.

EXPERIMENTAL METHOD

The purified lignin employed in this study was an "alkali" lignin prepared by treating ligneous plant residue with sodium hydroxide, followed by electrodialysis of the product. The author is indebted for its preparation to Emmett E. Bennett, of the Massachusetts Agricultural Experiment Station.

The soil employed was Connecticut Valley sandy loam. The plot from which the soil was taken had been used previously for the cultivation of tobacco, but had been allowed to lie fallow during the season in which the soil was taken in the late summer for this investigation.

The soil was brought into the laboratory, where it was air-dried and screened through a 40-mesh screen. Following determination of its water-holding capacity, 100-gram quantities were put into glass tumblers and materials added as follows: calcium carbonate; calcium carbonate and mannite; calcium carbonate, mannite, and dipotassium phosphate to furnish

[1] Contribution No. 571 of the Massachusetts Agricultural Experiment Station.

phosphorus and potassium. The quantities of these added substances per 100 grams of soil were: mannite, 1 gram; calcium carbonate, 0.2 gram; and dipotassium phosphate, 0.3 gram. Calcium carbonate was added because the reaction of the soil as taken from the field was about pH 5; mannite, to observe the effect of an added source of energy; and phosphorus and potassium, because of the known lack of these materials in the type of soil employed. The amounts of these several substances were based upon previous experience in this laboratory with this type of soil.

TABLE 1

NITRIFICATION OF DRIED BLOOD AND AMMONIUM SULFATE IN SOIL WITH AND WITHOUT PURIFIED LIGNIN

Treatment	Incubation period	Dried blood series		Ammonium sulfate series	
		Soil without lignin; ppm nitrate nitrogen	Soil with lignin; ppm nitrate nitrogen	Soil without lignin; ppm nitrate nitrogen	Soil with lignin; ppm nitrate nitrogen
	(mos.)				
Calcium carbonate	2	528	416	45	26
	3	728	432	51	40
	4	691	365	46	45
Calcium carbonate and mannite	2	480	297	46	27
	3	485	328	44	29
	4	472	310	41	29
Calcium carbonate, mannite, and dipotassium phosphate	2	272	273	36	25
	3	305	267	38	28
	4	269	237	40	31

Two sets of tumblers were prepared of each mixture. To one set purified lignin was added at the rate of 2 grams/100 grams of soil. To the duplicate set no lignin was added.

Two series of experiments were set up. In one, dried blood (about 12 per cent nitrogen) was added at the rate of 1 gram/100 grams of soil; in the other, an aqueous solution of ammonium sulfate was added at a rate to supply 30 mg. of nitrogen/100 grams of soil. After all of the materials had been thoroughly mixed in the respective tumblers, distilled water was added to 60 per cent of the water-holding capacity of the soil. The ammonium sulfate was added by dissolving it in the water used to moisten the soil. This technique for nitrification study is essentially that employed by Waksman (*5*).

After the water had been added, the tumblers were covered with waxed paper and weighed. During the incubation period the tumblers were weighed twice each week, and water was added to make up any loss. The tumblers were put into dark cupboards and allowed to stand at room temperature. One-third of the tumblers from each category were tested for nitrates at two months, one-third at three months, and the final third at four months. Nitrate determinations were made colorimetrically by the phenoldisulfonic acid method (*1*).

The experiments were so set up that triplicate tumblers were available for each determination. The results, shown in Table 1, were nearly enough alike for each triplicate set of tumblers to justify the use of averages.

RESULTS

In the tumblers containing dried blood the results showed that:

(1) In the presence of calcium carbonate the amount of nitrate in tumblers without lignin was much greater than when lignin was present.

(2) When both mannite and calcium carbonate were present, the same relationship existed as with calcium carbonate alone, but nitrate values for both lignin and nonlignin tumblers were lower than in the comparable tumblers without mannite.

(3) When dipotassium phosphate was added to calcium carbonate and mannite, all nitrate values were much lower than with calcium carbonate alone or with calcium carbonate and mannite. Nitrate values in the absence of lignin were not much greater than in its presence; in fact, they were about the same at the end of the first two months.

(4) Most nitrate values increased from two months to three and then decreased at four months. In some instances the values at four months were lower than those at two months.

(5) In all instances, except the one mentioned in (3), the values in the presence of lignin were definitely lower than in its absence.

In the tumblers containing ammonium sulfate, the nitrate values in the presence of lignin were lower than in its absence. The length of the incubation period exerted little influence, except for the slight influence shown in the presence of calcium carbonate alone, which resembled the effect noted with dried blood but to a much smaller extent. The presence of mannite and dipotassium phosphate did not exert the noticeable effect obtained with dried blood.

The recovery of nitrate nitrogen was relatively much less in the ammonium sulfate series than in that with dried blood. This may have been due to the absorption of NH_3 by lignin, mentioned by Waksman and Hutchings (*6*).

The reason is not apparent for the lower nitrate results obtained when mannite and dipotassium phosphate were added to soil in the dried-blood series. A check of the pH values of the soil in the tumblers gave no information that could explain the phenomenon.

CONCLUSION

It may be concluded that the presence of purified

lignin in sandy loam soil definitely reduced the amount of nitrate nitrogen recovered from either dried blood or ammonium sulfate. The effect was much more marked with the dried blood than with the ammonium sulfate.

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Administration of Streptomycin in Peanut Oil and Beeswax and in Solvecillin

John A. Kolmer, Amedeo Bondi, Jr., Halsey F. Warner, and Catherine Dietz

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One of the most effective methods for delaying the absorption and excretion of penicillin, with the prolongation of effective serum levels, is by intramuscular or subcutaneous injections of the compound suspended in sterile peanut oil and beeswax, as first proposed by Romansky and Rittman (*7*) in 1944. Fixed oils themselves delay absorption, but the addition of beeswax enhances these effects. Since then their observations have been amply confirmed by various investigators (*1, 4, 6, 9*). Freund and Thomson (*3*) have also proposed the administration of penicillin in water-in-oil emulsion for slower absorption, using as a vehicle a lanolin-like substance prepared from oxycholesterins and cholesterol esters commercially available under the name of "solvecillin."

Neither of these methods has been reported upon in relation to the administration of streptomycin. Since the indications for slow absorption with prolonged therapeutically effective serum levels are the same as in penicillin therapy, the purpose of this investigation was to study the absorption and excretion of streptomycin suspended in peanut oil and beeswax and in solvecillin administered by intramuscular injection.

Single doses of streptomycin[1] suspended in 2 cc. of sterile peanut oil and 4 per cent beeswax were administered by intramuscular injection to adults of approximately the same body weight. The local reactions were quite mild and similar to those produced by intramuscular injections of similar amounts of streptomycin dissolved in sterile saline solution. One subject showed a delayed reaction occurring 7 days after injection and characterized by a generalized urticaria.

Emulsions in solvecillin were prepared by dissolving streptomycin in 1.4 cc. of sterile saline solution and adding the solution to 3.1 cc. of previously warmed solvecillin followed by thorough emulsification. Single doses of the compound in a total dose of 4.5 cc. of menstruum were likewise administered by intramuscular injection to adults of approximately the same body weight. Only mild local reactions resulted.

At intervals of 1, 2, 3, 4, 6, and 24 hours thereafter blood and urine were collected for assay purposes, each specimen of urine being measured and the total excretion of streptomycin calculated on the basis of units/cc. All assays were conducted according to the method of Stebbins and Robinson (*8*), using *Staphylococcus aureus* (SM strain).

Table 1 shows the serum levels and urinary excretions observed in three subjects following single intramuscular injections of 250,000 units of streptomycin suspended in 2 cc. of sterile peanut oil and 4 per cent beeswax. It will be observed that only one sub-

TABLE 1

Intervals*	Subject No. 1				Subject No. 2				Subject No. 3			
	Serum (units/cc.)	Urine			Serum (units/cc.)	Urine			Serum (units/cc.)	Urine		
		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units
1	0	154	11	1,694	0	75	17	1,275	Trace	430	1.6	688
2	0	40	35	1,400	0	75	20	1,500	"	175	10.0	1,750
3	0	140	48	6,720	0	200	4.8	960	0			
4	0	45	35	1,575	0	205	1.8	369	0	350	10.0	3,500
6	0	80	37	2,960	0	200	6.0	1,200	0			
24	0	660	6.5	4,290	0	1,150	2.0	2,300	0	1,020	6.1	6,222
Totals		1,119		18,639		1,905		7,604		1,975		12,160
Per cent† .				7.4				3.4				4.8

* Hours after administration of streptomycin.
† Per cent of injected dose of streptomycin excreted in the total 24-hour urine.

[1] Streptomycin sulfate kindly supplied by the Abbott Laboratories, North Chicago, Illinois.

ject (No. 3) showed a trace of the compound in serum collected 1 and 2 hours after treatment. The total urinary excretion of the compound over a period of 24 hours varied from 3.4 to 7.4 per cent of the amount administered. Similar doses dissolved in 2 cc. of sterile saline solution and administered to three adults by intramuscular injection showed serum levels of 1.5, 3.0, and 2.5 units/cc., respectively, at the end of 6 hours, with total excretions of 22.0, 24.0, and 48.0 per cent of the amounts administered in the 24-hour urine (*5*).

Table 2 shows the serum levels and urinary excretions observed in three additional subjects following single intramuscular injections of 500,000 units of streptomycin suspended in 2 cc. of sterile peanut oil and 4 per cent beeswax. It will be observed that the serum level of the compound in one subject (No. 4) was 2.5 units/cc. at the end of 6 hours but that only traces of the compound appeared in the serum of the remaining two subjects at the end of this period. The total urinary excretion in 24 hours varied from 6.6 to 23 per cent of the dose administered. Similar doses dissolved in 2 cc. of sterile saline solution and administered to three adults by intramuscular injection showed serum levels of 1.0, 2.5, and 2.5 units/cc., respectively, at the end of 6 hours, with total excretions of 36.0, 41.0, and 75.0 per cent of the amounts administered in the 24-hour urine (*5*).

As expected, the absorption of streptomycin administered in water-in-oil emulsions (solvecillin) was much more pronounced than that following intramuscular injections of the compound suspended in peanut oil and beeswax. As shown in Table 3, the serum levels in three subjects at the end of 6 hours following intramuscular injections of 250,000 units in solvecillin were 1.5, 2.5, and 1.5 units/cc., respectively, and closely similar to the results observed following the intramuscular injection of 250,000 units dissolved in 2 cc. of sterile solution. The total excretions in the 24-hour urine varied from 13 to 34 per cent of the amounts of streptomycin administered.

It appears, therefore, that streptomycin suspended in peanut oil and beeswax is not absorbed from the muscles as readily as penicillin. Similar results have been observed in the administration of streptomycin suspended in peanut oil and 3 per cent beeswax to guinea pigs by intramuscular injection (*2*). This slow absorption probably results in a greater fixation or inactivation of streptomycin in the tissues, accounting for the low serum levels and reduced urinary excretions. Maintenance of minimum effective serum levels over a period of 6 hours requires the injection of more than 500,000 units per dose. Absorption after intramuscular injections of the compound emulsified in solvecillin is more pronounced and similar to that following injections of the compound dissolved in saline solution, but serum levels following intramuscular injections of 250,000 units in solvecillin were not

TABLE 2

Intervals	Subject No. 4				Subject No. 5				Subject No. 6			
	Serum (units/cc.)	Urine			Serum (units/cc.)	Urine			Serum (units/cc.)	Urine		
		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units
1	5.0	225	20	4,500	3.0	42	115	4,830	2.5	143	55	7,865
2	5.0	110	120	13,200	3.0	27	183	4,941	2.5	87.5	133	11,638
3	4.0	50	200	10,000	4.0	29	168	4,872	2.0	46	140	6,440
4	3.5	160	80	12,800	2.0	57	100	5,700	2.0	41	113	4,633
6	2.5	170	80	13,600	Trace				Trace	121	28	3,388
24	0	1,260	51	64,260	0	625	21	13,125	0	1,495	23	34,385
Totals		1,975		118,360		780		33,468		1,933.5		68,349
Per cent ..				24				6.6				14

TABLE 3

Intervals	Subject No. 7				Subject No. 8				Subject No. 9			
	Serum (units/cc.)	Urine			Serum (units/cc.)	Urine			Serum (units/cc.)	Urine		
		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units		Vol. (cc.)	Units/cc.	Total units
1	1.0	190	18	3,420	5.5				7.0	65	230	14,950
2	1.0	52	13	676	5.0				4.5	35	400	14,000
3	2.5	108	70	7,560	4.5	158	150	23,700	2.5	120	150	18,000
4	2.0	190	27	5,130	3.0				2.0	185	40	7,400
6	1.5	165	23	3,795	2.5				1.5	225	45	10,125
24	0	910	14	12,740	0	650	45	29,250	0	340	60	20,400
Totals		1,615		33,321		808		52,950		970		84,875
Per cent ..				13				21				34

high as those following intramuscular injections of 00,000 units suspended in peanut oil and beeswax.

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ffect of Di-Isopropyl Fluorophosphate (DFP) on the Action Potential of Muscle

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Di-isopropyl fluorophosphate (DFP) abolishes the erve action potential, but this effect is reversible for limited period of time. DFP is a strong inhibitor of cholinesterase. A striking parallelism between the reappearance of the action potential and cholinesterase activity in nerve can be demonstrated during the recovery from DFP poisoning. The inhibition of cholinesterase by DFP can also be reversed *in vitro* during a period of time comparable to that in the experiments on nerves (*1*). These observations are consistent with the concept that cholinesterase activity and, consequently, the release of acetylcholine are essential events in the conduction of the nerve impulse.

It is generally considered that the mechanisms of the axonal and end-plate potentials are basically identical (*4*). The role of acetylcholine in the end-plate potential is supported by the relation between the activity of cholinesterase and the action potential of the electric organ, which may be considered analogous to the end-plate potential (*5*). Further support is found in the persistence of the high cholinesterase concentration at the motor end plate after complete degeneration of the axon (soleplate) (*2, 3*).

No facts are available concerning the chemical mechanism involved in the action potential of muscle, although many physiologists believe that the electrical manifestations of nerve and muscle are fundamentally identical. Muscle fibers and nerves are the only tissues which contain specific cholinesterase (*6*). This makes possible the assumption that acetylcholine plays a role in both tissues. However, the presence of an enzyme alone does not permit an interpretation of its function. We have therefore tested whether DFP abolishes the action potential of muscle as it does that of nerve.

Frogs (*Rana pipiens*) were curarized with crystalline *d*-tubocurarine chloride (Squibb). After curarization, the sartorius muscle was excised and mounted in a specially constructed chamber. The action potentials evoked by single electrical stimuli were recorded by means of a cathode-ray oscillograph. When not stimulated, the muscle was kept immersed in a Ringer solution containing 0.1 mg./cc. of curarine. This solution was then replaced by an identical solution containing DFP. Under the effect of DFP the action potential of the muscle rapidly disappears. With a concentration of 2 mg. of DFP/cc., the action potential is abolished in as little as 8 minutes. With a concentration of 1 mg. of DFP/cc., the abolition takes longer (20–30 minutes). After washing with the curarine Ringer solution (without DFP) the reappearance of the response is observed.

These experiments present the first evidence that acetylcholine may play a role in the muscle action potential. They are consistent with the idea that the natures of axon, end-plate, and muscle action potentials are basically identical.

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Derivation, Interpretation, and Application of the Second Law of Thermodynamics

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The second law of thermodynamics is commonly derived by means of an extended series of differential equations not easy to follow and involving so many assumptions and limitations that the result is not altogether convincing. Its physical interpretation is given in a wide variety of statements. That a number of the fundamental relations of thermodynamics may be simply and directly derived from it appears to have been entirely overlooked. It is here derived as a by-

product of Gibbs's masterful general treatment, but apparently neither Gibbs nor any of his followers ever noted it.

As with the generalized potentials of mechanics, the thermodynamic potential of Gibbs, $U - ST + pv$, is of little interest except in its differential form, $dU - TdS - SdT + pdv + vdp$. This is, of course, zero throughout any body of uniform temperature, pressure, and composition, since the total energy added (dU), the thermal energy ($dQ = TdS$), and the mechanical work ($dW = pdv$) must sum up to zero,

(1) $dU - TdS + pdv = 0$; hence also
(2) $-SdT + vdp = 0$, the Second Law.

This derivation and statement ($SdT = vdp$) of the second law is as simple as could be desired. In this form it is too general to apply to special groups of problems until relations between two or more of its four variables are given. In the form (2), it is essentially an equation of state. Mathematics does not give the relation between vdp and pdv, but physical data indicate that they are proportional to each other and in a few cases equal. They have identical dimensions (energy). The same may be said of SdT and TdS.

In physical terms, the second law states that the thermal and mechanical energy functions (SdT and vdp) remain equal whatever the nature and amount of the external energy (dU) added or removed, for any body in any state, so long as p, T, and composition are uniform throughout.

Some applications of (2) to groups of physical problems will illustrate the methods used and indicate how it may be checked with experimental data. When a body exists in *two phases,* such as a melting solid or a liquid and its vapor, $dT : dp$ is the same for both phases, and (2) becomes $S_2 - S_1 = (v_2 - v_1)\, dp : dT$, the subscripts referring to the two phases. But $T(S_2 - S_1) = L$, the latent heat; therefore

$$(3)\quad L = T(S_2 - S_1) = T(v_2 - v_1)\frac{dp}{dT} = p(v_2 - v_1)\frac{d \log p}{d \log T}.$$

This is the familiar Clausius equation for the variation of vapor pressure with temperature. It applies equally to the change of melting point with pressure. With the limitation that one specific volume is negligibly small compared with the other, $pv_2 = RT$, and (3) becomes the Le Chatelier-van't Hoff equation, $d \log p : d \log T = L : RT$. Other slight modifications give the "reaction isochore" of Nernst and the Arrhenius-Boltzmann equation for atomic heats. The extension to three phases is obvious.

In applying the second law to deformation within a *single phase* it is to be noted that here S and v vary continuously with p and T. Hence, instead of $S_2 - S_1$ and $v_2 - v_1$ we have dS and dv, and therefore (2) takes the form

$$(4)\quad \frac{dT}{dp} = \frac{dv}{dS},$$

which is applicable to changes within a single phase without any other limitation. Within one phase $TdS = dQ = C_p dT$ and $dv = \alpha v dT$. Note that the thermal coefficient of expansion (α) is not limited to constant values as in the inexact integral form, $v = v_0(1 + \alpha(T - T_0))$.

These substitutions of dv and dS in (4) give at once the celebrated Thomson (Kelvin) equation,

$$(5)\quad \frac{dT}{dp} = \frac{T\alpha v}{C_p},$$

for the change in temperature caused by change of pressure, developed by him about 1850 using many pages of differential equations still copied in every modern texts. Equation (5) has been amply verified by experimental data and has been applied by the writer (paper in press) to the Washington monument data on steel tape of Van Orstrand. In (5), v is the volume of unit mass, since specific heat (C_p) is so limited. The heat developed in any volume is $dQ = T\alpha v dp$. Writing $dv = v\beta dp$, $dT : dp = \beta : \alpha$. The entropy of deformation $dS = \alpha v dp$.

A simple, useful relation between heat and work is obtained by multiplying (4) by p/T. Thus,

$$(6)\quad \frac{pdT}{Tdp} = \frac{pdv}{TdS} = \frac{dW}{dQ} = \frac{d \log T}{d \log p},$$

a dimensionless ratio that may be read directly from a log T, log p plot of data. For viscous flow (steady state) $dw = dQ$.

These single-phase relations (4, 5, and 6) hold for either adiabatic or isothermal conditions with corresponding volume coefficients. Isothermal $\beta = k\beta$ adiabatic ($k = C_p : C_v$, the ratio of specific heats), while for the α's this ratio is $1 - k$. The relations between p and v are consistent with $pv^k = \text{constant}$, which has been shown to hold well for metals as well as gases.

The derivation of the second law here given indicates that the first and second laws are but conjugate parts of a single general expression for equilibrium. In the simple form ($SdT = vdp$) given, the second law was shown to lead directly to the well-known Clausius equation for vapor pressure and the Thomson equation for single-phase heat of compression. Similar applications to groups of problems of wide variety are indicated. The second law has been a *bête noir* of theoretical physics, but it should become a friendly work horse, easily managed, useful, and well understood.

News and Notes

Special AAAS Notices

Hotel headquarters for the Boston Meeting of the AAAS are announced as follows:

General Headquarters: The Statler Hotel will serve as the general headquarters of the Association, housing the meetings of the Council and Executive Committee.

Headquarters of the sections of the Association and of the societies meeting with the Association follow:

Statler Hotel: Section on Medical Sciences (N), Subsections on Dentistry (Nd) and Pharmacy (Np); Academy Conference, American Microscopical Society, American Society of Naturalists, American Society of Parasitologists, American Society of Zoologists, Genetics Society of America, Ecological Society of America, Limnological Society of America, National Association of Science Writers, Sigma Delta Epsilon, Society for the Study of Evolution, Society of the Sigma Xi, United Chapters of the Phi Beta Kappa.

Bradford Hotel: Sections on Anthropology (H), Psychology (I), and Education (Q); American Nature Study Society, National Association of Biology Teachers, National Science Teachers Association, Pi Lambda Theta.

Commander Hotel: Sections on Astronomy (D) and Geology and Geography (E); American Astronomical Society, American Meteorological Society. Meetings of these sections and societies will be held at Harvard University.

Copley Plaza Hotel: Section on Botanical Sciences (G); American Fern Society, American Society for Horticultural Science, American Society of Plant Physiologists, American Society of Plant Taxonomists, Botanical Society of America, Mycological Society of America, Phi Sigma Biological Society, Sullivant Moss Society.

Kenmore Hotel: Sections on Physics (B), Chemistry (C), Social and Economic Sciences (K), History and Philosophy of Science (L), and Engineering (M). Meetings of these sections will be held at the Massachusetts Institute of Technology.

Hotels adjacent to the Bradford are the Avery and Touraine; those adjacent to the Copley Plaza are the Charlesgate, Fensgate, Pioneer (for women), Copley Square, Lenox, and Vendome; those adjacent to the Kenmore are the Puritan, Braemore, Myles Standish, Sheraton, Buckminster, Gardner, and Minerva.

The Lincolnshire, Commonwealth, Bellevue, and Parker House hotels are grouped about the Boston Common and are within convenient walking distance of the Statler and Bradford hotels. The Commander and Continental hotels are adjacent to Harvard University.

Chemistry Section (C). Persons desiring to present general papers on various phases of chemistry at the Boston Meeting of the AAAS are invited to submit abstracts in triplicate to Dr. E. F. Degering, Department of Chemistry, Purdue University, Lafayette, Indiana. Abstracts should not be over 200 words and will not be considered if received after 21 October. Please indicate the approximate delivery time and, if projection equipment is desired, specify the type and size.

About People

E. F. Phillips has retired from the Department of Entomology, College of Agriculture, Cornell University. Dr. Phillips has been professor of apiculture at Cornell since 1924 and in 1935 was president of the American Association of Economic Entomologists.

E. D. Merrill resigned as director of the Arnold Arboretum, Harvard University, on 31 July. He remains at the institution in his capacity of Arnold professor of botany until his retirement in 1948.

Arthur M. Ginzler, for four years chief of the Section of Experimental Pathology, Medical Division, Chemical Warfare Service, has returned to his former position as pathologist and director of laboratories, Sydenham Hospital, New York City.

Jacinto Steinhardt, director of research of the Navy's Operations Evaluation Group, has been awarded the Medal of Freedom for his work with the Seventh Fleet in the Southwest Pacific.

Demorest Davenport, recently relieved from active duty with the Aviation Physiology Program, Army Air Forces, has been appointed assistant professor of zoology, Santa Barbara College, University of California.

T. A. Merrill, formerly associate professor and research associate in horticulture, Michigan State College, has been appointed professor and head of the Department of Horticulture, College of Agriculture, and chairman of the Division of Horticulture, Agricultural Experiment Stations, State College of Washington, Pullman.

William J. K. Harkness, chief of the fish and wildlife division of the province of Ontario and a faculty member of the University of Toronto, received the

degree of Doctor of Science from The Ohio State University on 14 July, in ceremonies at the Franz Theodore Stone Laboratory, Put-in-Bay, Ohio.

Paul P. Weinstein, S. A. sanitarian (R) of the Parasitology Section of the Laboratory Division, Communicable Disease Center, U. S. Public Health Service, was recently assigned to the School of Tropical Medicine, San Juan, Puerto Rico.

John G. Thompson has been appointed chief of the Metallurgy Division at the National Bureau of Standards. Dr. Thompson has been chief of the Bureau's Chemical Metallurgy Section since 1930 and assistant chief of the division which he now heads since 1942.

James T. Jardine, chief of the Office of Experiment Stations, U. S. Department of Agriculture, since 1931, retired on 31 July. He was succeeded by R. W. Trullinger.

Theodore M. Sperry was appointed assistant professor of biology, Kansas State Teachers College, Pittsburg, on 3 June. The appointment followed his release from four and one-half years of service in the Army Air Forces.

Emil Ott and *Eero Erkko,* Hercules Powder Company, left for Europe on 7 August on a two-month tour of chemical plants in England, Sweden, Switzerland, Holland, Belgium, and France. Dr. Ott is director of research of the Company.

B. F. Daubert and *Leo S. Mason* have been promoted to research professor and associate research professor, respectively, in the Department of Chemistry, University of Pittsburgh.

Robert Bryan Payne, formerly instructor in psychology, Indiana University, Indianapolis Division, has joined the Research Staff, Department of Aviation Psychology, Randolph Field, Texas. He has been associated with the Aviation Psychology Program of the Army Air Forces for the past four and one-half years.

Charles O. Warren, assistant professor of physiology and anatomy, Cornell University Medical College since 1942, joined the staff of the Commonwealth Fund on 1 August as medical associate.

Lincoln C. Pettit, formerly assistant professor, Washington and Lee University, and after the war a member of the teaching and administrative staffs at Biarritz American University, France, has been released from active duty as a lieutenant colonel in the Army and has been appointed assistant professor of biology at St. Lawrence University, Canton, New York.

Sidney Paige, senior engineering geologist, and since 1935 in the North Atlantic Division, Army Engineers, has been named visiting professor of engineering geology at Columbia University.

Rudolf J. Noer has been made professor of applied anatomy, Wayne University College of Medicine, while retaining his position as associate professor of surgery.

Thomas B. Douglas, formerly on the Manhattan Project, has been appointed assistant professor of chemistry, Western Reserve University.

John A. Russell has been appointed assistant professor and head of the Department of Astronomy, University of Southern California. The appointment became effective on 1 September.

Hugo Osvald, professor of plant husbandry at the College of Agriculture, Uppsala, Sweden, and secretary of the Executive Committee of the Seventh International Botanical Congress, has been visiting the United States. On 20 July he was the guest of the American officers of the Botanical Section of the International Union of Biological Sciences, at Harvard University, with whom he discussed plans for the next Congress, to be held in Stockholm in the early summer of 1950. Frans Verdoorn, botanical secretary of the Union, has, at the request of the Executive Committee, undertaken the preparation of a new international plant science register and directory, similar to the early volumes of *Chronica Botanica,* which will be issued about a year before the Congress.

James B. Finn, Jr., associate professor of biology at Mount Mercy College and lecturer in biology at the University of Pittsburgh, has joined the staff of the W. B. Saunders Company, Philadelphia, as an educational representative.

B. J. Kaston, Zoology Department, Syracuse University, has been appointed associate professor of biology at the Teachers College of Connecticut, New Britain.

Eugene Kisch left for South America on 25 July in order to give two lectures on "Bone and Joint Tuberculosis" at the Institute of Tuberculosis, Faculty of Medicine, Montevideo, Uruguay, and one on "Prevention of Tuberculosis" at the Departamento Nacional de Salubridad, Buenos Aires, Argentina. Dr. Kisch also presented two papers on "Postwar Tuberculosis" at the National Academy of Medicine in Rio de Janeiro and São Paulo.

Eugene C. Crittenden, associate director of the National Bureau of Standards, has been made a member of the International Committee on Weights and Measures. The International Committee, consisting

of 16 scientists chosen from the 32 member nations, is engaged in developing scientific standards of measurement and in securing their uniformity throughout the world. The meetings of the Committee, interrupted during the war, are now to be resumed, and the first postwar session will be held at Sevres, France, beginning on 22 October 1946.

Fred D'Amour, professor of zoology at the University of Denver, has recently been appointed director of the University's newly established Bureau of Physical and Biological Research and chairman of the Department of Zoology.

Garvin L. Von Eschen, formerly of the University of Minnesota, has assumed his duties as chairman of The Ohio State University's new Department of Aeronautical Engineering.

C. Ladd Prosser has been released from the Manhattan Project after three years of service at the Metallurgical Laboratory, University of Chicago, and has returned to the Department of Zoology and Physiology, University of Illinois, Urbana.

Maurice M. Shapiro has been appointed senior physicist at the Clinton Laboratories, Oak Ridge, Tennessee. During the war Dr. Shapiro was a group leader at the Los Alamos Laboratory of the University of California and was formerly chairman of the Association of Los Alamos Scientists.

Frederick W. Smither, chemist at the National Bureau of Standards since 1914 and authority on the analysis of soaps and other detergents, retired on 31 August after 39 years of continuous Government service. He has been chief of the Section on Detergents and Miscellaneous Materials for 22 years, and from 1917 to 1924 was chief of the Section on Platinum Metals and Chemical Reagents.

Arthur B. Cleaves has been appointed associate professor of geology in the Department of Geology and Geological Engineering, Washington University, St. Louis.

J. Gordon Carlson has recently resigned his position as associate professor of zoology at the University of Alabama to accept an appointment as senior biologist in the Industrial Hygiene Research Laboratory, National Institute of Health, Bethesda, Maryland, where he will continue his research in the field of radiation cytology.

Walter W. Lewis, transmission engineer at the central station engineering division of the Schenectady General Electric works, has been appointed professor of electrical engineering at Union College.

Howard Bennett Sprague, formerly head of the Agronomy Department, New Jersey Agricultural Experiment Station, and professor of agronomy, Rutgers University, has been appointed head of the Agricultural Research Division, Texas State Research Foundation, Dallas. Dr. Sprague will assume his new duties on 1 January 1947, upon his release from active duty as a major in the Army Air Forces.

Lindsay S. Olive has been appointed associate professor in the Department of Botany, Bacteriology, and Plant Pathology, Louisiana State University, Baton Rouge.

B. S. Pickett became professor of horticulture at the University of Georgia on 1 September. For the past eight years he has been associated with the Experiment Stations of Texas.

J. A. Shellenberger has just returned to his duties as head of the Department of Milling Industry, Kansas State College, Manhattan, after serving for several months as a consultant to the Institute of Inter-American Affairs on an assignment to the Republic of Peru.

Announcements

The "Electropult," an electric catapult, may soon be capable of launching the Nation's largest airliner after a take-off run of only 500 feet, according to Westinghouse engineers. The Electropult, which was originally designed for the Navy during the war for the purpose of reducing the length of runway required for take-off on small Pacific islands, has been described as an electric motor, turned inside out and rolled flat. The device consists essentially of a turtle-like shuttle car, 5 inches high, to tow the plane to be launched, riding on a 1,380-foot track mounted flush with the ground and containing more than 300,000 sheets of electrical steel and nearly 17,000 high-resistance metal bars in its core. The power, which is supplied from a plant housed in a sunken concrete chamber beside the track, is thus delivered in a straight line instead of in the rotating pattern of the usual motor. At recent tests at the Naval Air Test Center, Patuxent River, Maryland, the car built up a speed of 226 miles an hour in slightly less than 500 feet, while running without a load. Possible applications of the Electropult in the commercial aviation field are: on floating airports for refueling purposes; on barge-type airports for cities with suitable harbors; on mid-city airports, in which slum elimination projects may be combined with airport development; and for rearrangement of outgrown or overgrown airports.

Scientific and technical personnel, peculiarly qualified to work on research and development projects by reason of their education and experience, will be assigned in the Army by a newly established War De-

partment technical detachment. Personnel directed by the technical detachment will be classified as critically needed specialists and will be assigned only to such duties as will make effective utilization of their educational and professional backgrounds. On completion of each project, such persons will report back to the Director of Research and Development, War Department General Staff, for release or reassignment.

The policies for the operation of this detachment will be established by a committee composed of representatives of the following: Director of Personnel and Administration, WDGS; Director of Research and Development, WDGS; Commanding General, AAF; Commanding General, Army Ground Forces; and The Adjutant General, acting for the technical services. This committee will examine the qualifications of all personnel suggested for this work and make recommendations for assignment to the technical detachment.

Columbia University has received the Naval Ordnance Development Award for its wartime research and development of torpedoes and gun sights, according to Frank D. Fackenthal, acting president of Columbia. In addition to the award, certificates were also presented to the University's Special Studies and Applied Mathematics Groups for work on the Torpedo Mark 25 and on Gunsights Mark 18 and Mark 23, respectively.

Field work in a comprehensive study of cosmic rays at various altitudes has been completed jointly by the National Geographic Society, U. S. Army Air Forces, and the Bartol Research Foundation of the Franklin Institute (see *Science,* 1946, **103,** 81). The investigations, made in a B-29 bomber equipped as a laboratory, involved round-trip flights ranging between Latitude 50° North, in southern Canada, and Latitude 20° South, off the coast of northern Chile, near the magnetic equator.

The plane arrived in Washington, D. C., on 12 August, after having made five round trips over its 4,800-mile course. Two of the round-trip flights were at an altitude of 5,000 feet, and three others were at 15,000, 25,000, and 35,000 feet. The complete records of the flights are now under study at the Bartol Research Foundation. In the joint project, the National Geographic Society is represented by Lyman J. Briggs, chairman of its Research Committee; the Army Air Forces, by Maj. Gen. Curtis E. Le May, deputy chief of air staff in charge of research and development; and the Bartol Research Foundation, by its director, W. F. G. Swann.

The principal apparatus in the airplane consisted of multiple banks of Geiger counters occupying a space six feet by two feet. Counters were arranged in vertical banks of three in order to register only particles moving vertically downward. A shield of lead six inches thick, immediately above the counters, screened out all rays and particles with lesser energies than protons and mesotrons. The passage of each ray through a unit of three counters was recorded as a dot on a moving strip of sensitized paper, so that the greater the cosmic ray intensity, the more numerous the recorded dots.

The only previous studies of cosmic ray intensity covering such a great range of latitude were made at sea level, notably those of A. H. Compton and R. N. Turner, and J. Clay.

The U. S. Department of Agriculture, in order to fulfill its exchange agreements during World War II, held in storage its new bulletins and issues of periodicals intended for countries outside of the American Hemisphere. The material was placed in addressed envelopes and kept in shipping boxes that held, on an average, about 850 publications in envelopes. Shipment was started in January of this year, and in six months 219 boxes were forwarded to 34 countries. Still held in September were 86 boxes for 9 countries. The largest number of boxes, almost double the number for any other country, was accumulated for Japan.

The Laboratory of Vertebrate Biology, University of Michigan, announces the following appointments and changes in staff: L. C. Stuart has been transferred from the Museum of Zoology and placed on a full-time basis in the Laboratory as assistant biologist; C. W. Cotterman has been promoted to assistant geneticist, with the rank of assistant professor of zoology; William Hovanitz has been appointed assistant biologist, with the rank of assistant professor of botany and research associate in the Botanical Gardens; James V. Neel, formerly in charge of the Heredity Clinic, was granted a leave of absence on 1 August for service in the Medical Corps; Harold F. Falls, Ralph Hile, and Claude W. Hibbard have accepted appointments as research associates in the Laboratory; and Mary Jane Lagler and Avery R. Test, as collaborators.

The Ninth Annual Louis Gross Memorial Lecture will be delivered by Roy R. Grinker, director of the Institute for Psychosomatic and Psychiatric Research and Training, Michael Reese Hospital, Chicago. The address, on "Psychiatric Objectives of Our Time," will be given at 8:30 P.M. on 23 October at the Jewish General Hospital, Montreal, and is under the auspices of the Montreal Clinical Society.

The Northwestern University Chemical Lecture Series opened on 1 October with a lecture by Pierce W. Selwood on "Applications of Magnetochemistry to Catalysis." The general topic for this fall is "Special Techniques in Chemical Research" and is, in a sense,

a continuation of the topic of the 1944 series. The admission fee for the complete series is $20.

The tentative program for the remainder of the series follows: 8 October, "Applications of Ion Exchange to Inorganic and Radiochemical Research": J. A. Swartout, Monsanto Chemical Company; 15 October, "Measurement of Surface Area by Gas Adsorption": Paul H. Emmett, Mellon Institute; 22 October, "Chromatography": D. W. MacCorquodale, Abbott Laboratories; 29 October, "The Application of Radiochemical Techniques to Chemical Research": Nathan Sugarman, Institute for Nuclear Studies; 5 November, "The Study of Surface Chemistry With the Aid of Single Crystals": Allan T. Gwathmey, University of Virginia; 12 November, "Photography of Macromolecules With the Electron Microscope": Ralph W. G. Wyckoff, National Institute of Health; 19 November, "Ultraviolet Spectroscopy in Biochemistry": Irving M. Klotz, Northwestern University; 26 November, "Microbiological Assay": Esmond E. Snell, University of Wisconsin; and 3 December, "Fractional Distillation": M. R. Fenske, Pennsylvania State College.

The National Institute of Health Research Fellowships, which were created in 1945, will be increased in number during 1946 and 1947, according to the U. S. Public Health Service. The fellowships are awarded to individuals who have had postgraduate work in institutions of recognized standing in the various fields of science allied to public health, such as biology, chemistry, physics, entomology, medicine, dentistry, and veterinary medicine. Recipients will be offered an opportunity for study and research in association with highly trained specialists in the candidates' chosen fields at the Institute or some other institution of higher learning.

Junior research fellowships are available to persons holding Master's degrees or to those who have completed an equivalent number of hours of postgraduate study. The stipend is $2,400 per annum. Senior research fellowships, carrying a stipend of $3,000 per annum, are available to those holding doctorates.

Applications for these fellowships may be made at any time during the year, are acted upon promptly, and are effective for one year from the time of the award with the possibility of renewal for a second year. Letters of inquiry should be addressed to the Director, National Institute of Health, Bethesda 14, Maryland.

The Department of Economic Entomology, University of Wisconsin, has announced the following new appointments to its staff: T. C. Allen, professor and chairman; Floyd Andre, professor and assistant director of the Experiment Station; John T. Medler, Robert J. Dicke, Roy D. Shenefelt, and E. H. Fisher, assistant professors; and R. K. Chapman, instructor. Those associated with the Department with no change in status include: C. L. Fluke, H. F. Wilson, and C. L. Farrar, professors; J. H. Lilly, associate professor; and William C. Roberts, instructor.

A one-week course in X-ray diffraction and spectrometry, conducted by North American Philips Company, Inc., in its New York showroom during the week of 16 September, was attended by about 50 technologists. Morning lectures were given by I. Fankuchen, Brooklyn Polytechnic Institute; Herbert Friedman, Naval Research Laboratory; M. H. Jellinek, M. W. Kellogg Company; and Drs. Parrish and Nielsen, of Philips Laboratories, Inc. Afternoons were devoted to laboratory work.

The Department of Mathematics, Princeton University, has announced the appointment of Emil Artin, of Indiana University, as professor of mathematics, and the promotion of Salomon Bochner, Claude Chevalley, and A. W. Tucker to full professorships.

The American Academy of Applied Nutrition began its eleventh year with a meeting in Hollywood, California, on 1 October. N. Philip Norman presented a paper on "What Are We Doing to Solve Our Nutritional Problem?" which was later discussed by Drs. Pottenger, Hawkins, Shriber, and Royal Lee.

The School of Medicine, Washington University, St. Louis, has received a grant of $270,000 from the U. S. Public Health Service for support of research on hypertension. The grant is effective over a five-year period, $70,000 to be spent the first year and $50,000 each year thereafter. The work will be under the direction of Harry Schroeder, who has been active in the study of hypertension, having described an enzyme in the kidney which affects blood pressure. Palmer Futcher, recently appointed assistant professor in charge of the Metabolism Division of the Department of Medicine, will take an active part in the hypertension research while also engaged in a study of electrolyte metabolism in cardiac failure under a grant from the U. S. Navy.

The Department of Geography, Syracuse University, has announced the appointment of four new staff members: Hibberd V. B. Kline, Jr., and John C. Duvall are to teach in the Department at the University, while Joseph Van Riper and Sidley K. Macfarlane have been appointed for the new extension colleges at Endicott and Utica, respectively.

A new graduate Division of Applied Mathematics has been organized at Brown University as an interdepartmental project of the Departments of Mathe-

matics and Physics and the Division of Engineering to meet the needs of schools and research laboratories for engineers, physicists, and mathematicians whose training extends beyond the accepted boundaries of their respective fields. The following professors have been appointed to the new Division: William Prager (chairman), applied mechanics; John Henry Marchant (director of research), engineering; Maurice Anthony Biot, applied physical sciences; George Frances Carrier, engineering; James Arthur Krumhansl, physics; Chia Chiao Lin, applied mathematics; and Rohn Truell, physics.

Students are admitted who have excellent undergraduate records in two of the following subjects: engineering, physics, and mathematics. Training in research is stressed for the advanced students. Fellowship funds have been provided by the Rockefeller Foundation.

The Department of Psychology, Washington University, St. Louis, has announced the following changes in its staff: M. E. Bunch, promoted to professor of psychology; Phillip H. DuBois, formerly of the University of New Mexico, appointed as professor of psychology and placed in charge of the testing program of the University; and Karl D. Kryter, formerly of the Psycho-Acoustic Laboratory, Harvard University, appointed as assistant professor. J. P. Nafe is head of the Department.

The Humble Lectures in Science, to be given at its Baytown Refinery, have been inaugurated this year as an annual program by the Humble Oil and Refining Company, Houston, Texas, for the purpose of keeping its technical personnel aware of the latest developments in science and engineering. Outstanding scientists will be invited each year to present topics in their fields of special study and research. The program for 1946–47 includes the following series of lectures: "High Polymers": C. C. Price, University of Notre Dame; "Transference of Processes From Small to Large Scale": E. R. Gilliland, Massachusetts Institute of Technology; "Special Topics in Hydrocarbon Chemistry": D. R. C. Fuson, University of Illinois; and "Spectra as Related to Structure and Thermodynamic Properties of Molecules": K. S. Pitzer, University of California. Each series of lectures will be given for a period of one to two weeks and the personnel selected to attend will devote full time to them.

Opportunities will also be provided for graduate-level courses in physical chemistry, organic chemistry, and chemical engineering, which will be given by scientists from neighboring institutions, such as Rice Institute and the University of Texas. Attendance of individuals selected for these courses will be part of their regular duties.

Meetings

The Electron Microscope Society of America and *The American Society for X-Ray and Electron Diffraction* will hold a joint winter meeting on 5-7 December at the Mellon Institute of Industrial Research and the University of Pittsburgh, Pittsburgh. Joint dinners have been planned for 5 and 6 December, and joint sessions of the two Societies will be arranged if the programs permit. Those wishing to attend the dinners should make reservations with Dr. Max Lauffer, University of Pittsburgh.

It is suggested that all members of the Societies and visitors who plan to attend the meetings arrange for hotel accommodations as early as possible. Information concerning the meetings may be obtained by writing to Dr. S. S. Sidhu, local chairman of the ASXRED, University of Pittsburgh, or to Dr. Earl A. Gulbransen, local chairman of the EMSA, Westinghouse Research Laboratories, East Pittsburgh, Pennsylvania.

The Association for Research in Nervous and Mental Disease and *The International League Against Epilepsy* will meet jointly on 13–14 December at the Waldorf Astoria Hotel in New York City. The subject for discussion will be "Epilepsy." Information about the meeting may be obtained from Thomas E. Bamford, Jr., Secretary, Association for Research in Nervous and Mental Disease, 115 East 82nd Street, New York 28, New York.

Elections

The Royal Society (London) has elected the following men as foreign members: Herbert Spencer Gasser, director of the Rockefeller Institute for Medical Research, New York; Frédéric Joliot, head of the National Center of Scientific Research, Paris; Theodor von Kármán, professor of aeronautics and director of the Guggenheim Aeronautics Laboratory, California Institute of Technology, Pasadena; and Erik Andersson Stensio, professor in the University of Uppsala and director of the Riks Museum, Stockholm.—*John D. Griffith Davies, Assistant Secretary* (The Royal Society).

The Royal Swedish Academy of Sciences elected H. J. Muller, Indiana University, to Foreign Membership at a meeting held on 22 May.

The Society for the Study of Development and Growth elected the following officers for the coming year at its sixth symposium, held at Rhode Island State College, Kingston, on 27–30 August: Ross Harrison, Yale University, president; George S. Avery, Brooklyn Botanical Garden, secretary; Francis O. Schmitt, Massachusetts Institute of Technology,

treasurer. Ross Harrison, and J. W. Marvin, University of Vermont, were elected to the Executive Committee.

Recent Deaths

William Shand, Jr., 27, instructor in chemistry at the University of California, Berkeley, was instantly killed in an automobile accident in Elko, Nevada, on 11 August.

Clarence J. Addis, Jr., 24, fellow in biology at Rice Institute, Houston, Texas, until he received his Ph.D. degree in parasitology in 1945, died on 4 July as the result of a brain tumor.

Sir James Jeans died on 17 September at his home in Surrey at 69 years of age. From 1905 to 1910 he was professor of applied mathematics at Princeton University. Upon returning to Cambridge he lectured in mathematics for a short time and later became secretary of the Royal Society for the decade 1919–29 and professor of astronomy at the Royal Institution. He was best known, however, for his popular books, of which *The mysterious universe* (1930) caused the most comment in the United States.

A Society for All Biologists

Many biologists believe that there is need for an organization for biologists comparable to the American Chemical Society, the National Society of Professional Engineers, the American Medical Association, the Institute of Physics, etc., in which the welfare of the individual members and the advancement of the profession are equal in importance to the dissemination of knowledge. During 1945 a group of biologists in Atlanta, Georgia, organized the American Society of Professional Biologists in an effort to meet this need. For the past year it has been promoted through personal correspondence, personal contact, and public presentation to several large groups of biologists assembled at national meetings of established scientific societies. The reception of the organization has been most encouraging, and formal establishment of the Society is progressing rapidly. In order to acquaint biologists with the proposed American Society of Professional Biologists, a brief summary is presented.

Biology, probably more than any other science, has branches or fields that attract thousands of people to them as hobbies. Therefore, among the essentials for the establishment of a professional group are (1) that the individual members be engaged in biology as a profession, and (2) that the individuals must have had sufficient training or experience in the field to be recognized as "qualified biologists." Three sets of qualifications for membership have been proposed:

Group I—a Ph.D. in a specialized field of biology with at least 8 years of training or experience;

Group II—a M.S. in a specialized field of biology with at least 9 years of training or experience;

Group III—a B.S. in biology, at least 10 years of training or experience, and the satisfactory passing of an examination in the field of specialization chosen by the candidate.

(Academic years would be 9 months each, "years of experience" would be 12 months each, and both would have to be obtained after completion of high school.) There would be the usual "grandfathers' clause" for those who have already established themselves in the field. Junior or associate membership would be open to those preparing to meet the requirements for full membership.

The objects of the Society would be to advance the public welfare through the activity of biologists; to promote the professional, social, and economic welfare of all professional biological scientists; to obtain public recognition of biological scientists as professional men and women; to establish and have recognized a Code of Ethics for biologists; to encourage the interest and participation of professional biological scientists in scientific, educational, and public affairs; to aid in the improvement of the training received by biological scientists; and to encourage cooperation in all matters of mutual interest to scientific societies whose membership is composed predominantly of professional biological scientists.

One of the problems confronting biologists today is the question of "licensing, certification, or registration," which is admittedly an important and delicate one and one that would soon have to be faced by the Society. In consideration of such programs, it must be borne in mind that several states are already taking action in that field, and the question may soon be: "Shall we, as biologists, prepare the standards and requirements that are to be used by these states, or shall we allow others to set those standards for us?" It is a subject in the consideration of which the science as a whole must take precedence over individual beliefs and pet ideas and about which much discussion must take place.

The following facts concerning the proposed American Society of Professional Biologists (American Society of Professional Biological Scientists has been suggested as a more appropriate name) should be emphasized:

(1) It is the only biological society to the knowledge of the organizing committee that requires high qualifications in training and experience for membership and in which the individual is of equal importance to the scientific program promoted.

(2) Its purposes do not conflict with any of the existing societies.

(3) It is so organized that it can readily cooperate with the existing societies to the benefit of all, and all branches of the biological sciences, *pure* and *applied,* are of equal importance.

(4) Once established, it presents a common meeting ground and clearing house for all qualified biologists through which the development of the science and the welfare of the individual may be advanced.—*Norman C. Laffer,* temporary chairman (University of Maryland).

In the Laboratory

A Collapsible Metal Stirrer

J. David Reid and Edmund M. Buras, Jr.
Southern Regional Research Laboratory
New Orleans, Louisiana

A collapsible stainless steel stirrer, designed in this Laboratory, has been found satisfactory for vigorous and turbulent stirring in narrow-necked flasks. It may be used with either a mercury seal, a stuffing box, or a pressure-tight bearing which can be made conveniently by reaming a hole slightly larger than the shaft in a 2-inch length of stainless steel rod and lubricating well during use.

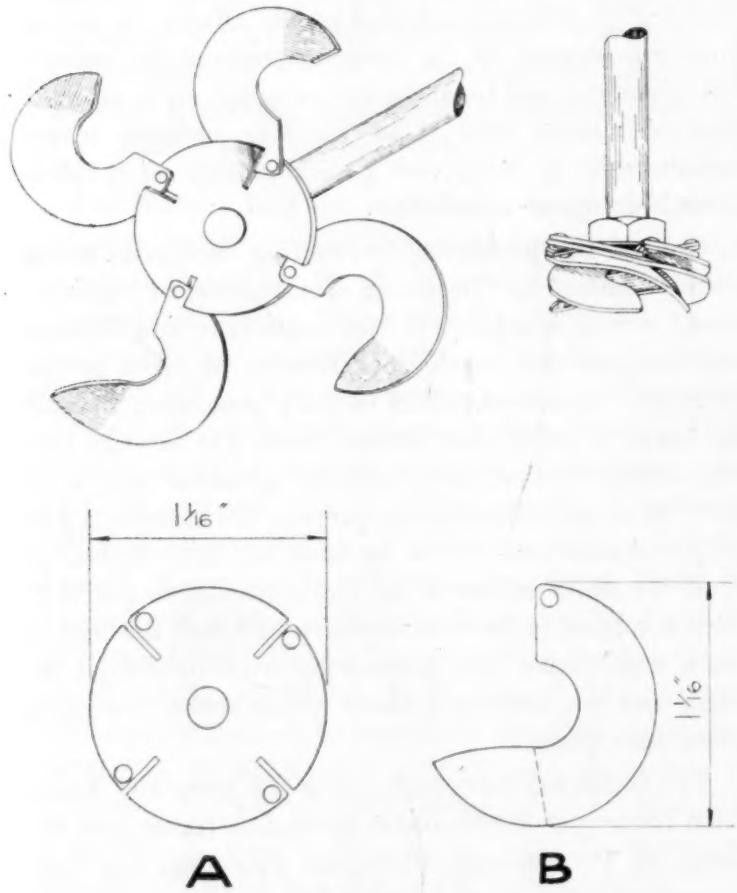

Fig. 1

This stirring device, shown in Fig. 1 in closed and open positions, is designed for insertion through a 34/45 standard taper joint. Five discs, 1 1/16 inch in diameter, were cut from a 16-gauge stainless steel sheet. A 7/32-inch hole was drilled in the center of one of these discs. Four rivet holes were then drilled and four 1/4-inch slots were cut in the periphery (Fig. 1, A). A 5/16-inch hole was bored in the center of each of the other four pieces, which were then cut to vane shape, and rivet holes were drilled (Fig. 1, B). Part of each vane was bent from the vertical plane at an angle of 30° at the point indicated by a dotted line (Fig. 1, B). (It is easier to drill or punch the center holes before cutting the discs from the original sheet.) The design shown is for a stirrer rotating counterclockwise and must be reversed for a motor rotating in the opposite direction.

A 1/4-inch stainless steel rod of appropriate length is then threaded, and on the upper side is screwed a stainless steel nut which, although not strictly necessary, serves to increase rigidity. Piece A is tapped and then screwed on the threaded rod against the nut, and the slight bottom projection is peened over. The quadrants of A are twisted through an angle of 15°. The four vanes are then riveted loosely to the underside of A. It is advantageous to drill rivet holes slightly larger than the rivets, since the latter tend to expand during the riveting operation, particularly if made from stainless steel rod. If the stirrer is properly assembled, each vane, when thrown open by centrifugal force, will rest against the upper side of the quadrant following it. When folded, the stirrer has a diameter no greater than that of A; when open, a diameter of approximately 3 inches.

An alternative design, using half discs instead of three-quarter discs for vanes, is much simpler to construct, requires but three original discs, and, being flatter, extends deeper into round-bottomed flasks—a particularly important consideration with small flasks. With such a stirrer, however, the action obtained is much less turbulent than that obtained with the bent three-quarter vanes.

Penicillin Blood-Level Determinations With a *Streptococcus dysgalactiae* Resistant to Normal Blood Inhibitors[1]

J. C. KAKAVAS
Haskell Research Foundation
University of Delaware, Newark
E. G. SCOTT
Delaware Hospital, Wilmington

Renewed interest has recently developed in the various methods that have been proposed for the determination of penicillin levels in body fluids. Elias, *et al.* (*2*) have pointed out that the two test organisms (*Streptococcus pyogenes* C-203 and *Bacillus subtilis*) commonly employed in determining penicillin blood levels are inhibited by human sera of normal subjects and ailing cases. Their data indicate that 49 per cent of normal adult sera have inhibitory substances against the streptococcus strain and 89 per cent against *B. subtilis*. Sera from patients showed a much higher percentage of inhibition. Chandler, Price, and Randall (*1*) made the same observations and attempted to overcome the natural blood bactericides by adding penicillinase to the system. The antisubtilis factor in normal human sera was determined in our laboratory, and it was found to be present in 66.6 per cent of 41 hospitalized cases before any medication was administered. Frieden and Frazier (*3*) have reported that the inhibition of staphylococcus growth which occurs in the presence of plasma or serum is due to the globulin fraction of the blood proteins. In view of these findings a new test organism was needed for use in determining penicillin levels in body fluids.

A search was made for an organism possessing the properties of high penicillin sensitivity and resistance to the normal blood bactericides. Tests of a large number of freshly isolated strains of mastitis streptococci revealed that most of these organisms were resistant to the normal blood bactericides and that their sensitivity to penicillin varied from 0.1 unit to less than 0.05 unit of penicillin/ml. in the test broth. One of these organisms was found to be sensitive to the extent that it was inhibited by 0.0025 unit of penicillin/ml. of broth. After a series of transfers in artificial media this organism became less sensitive, finally becoming stabilized so that it was inhibited repeatedly within the range of 0.006–0.008 unit/ml. of penicillin in broth. Furthermore, it grew more luxuriantly in tryptose broth containing normal serum from human, rabbit, or bovine sources. This strain was isolated from a clinical case of bovine mastitis. By means of physiological and serological reactions it was identified as *Str. dysgalactiae.*

Technique of the test. Tryptose broth medium (tryptose, 2 per cent; dextrose, 0.2 per cent; $Na_2HPO_4 \cdot 12H_2O$, 0.2 per cent; NaCl, 0.25 per cent; pH 7.2–7.4) is used to carry out the assays in this test. The serial dilution method is used, since it is rapid, simple to execute, and its accuracy is acceptable for routine testing of penicillin blood levels (*4, 5*). Serial dilutions are carried out as follows: Tryptose broth is distributed into 10 × 120 mm. sterile tubes. The first tube receives 1.2 ml., and the remaining, 1 ml. To the first tube is added .8 ml. of the blood serum to be tested. After thorough mixing, 1 ml. of the broth serum mixture is removed and added to the second tube. The serial dilution process is continued for the desired number of tubes. A parallel series of serial dilutions is prepared in which a standard penicillin solution of 1 unit/ml. is used in place of the serum. The test organism (*Str. dysgalactiae* 245) is grown in tryptose broth for 18 to 24 hours, and 0.1 ml. of a 1:100 dilution is added to each of the tubes. The number of organisms per inoculum will vary from 100,000 to 300,000 bacteria. The tubes are then incubated at 37° C., and the results are recorded 16 to 18 hours later. The last tube showing no growth is taken as the end point. The calculations for determining the penicillin content of the unknown are made by direct comparison with the standard penicillin tubes. If the tubes containing the unknown sample reveal no growth through the seventh tube and the tubes containing the standard penicillin also show the same result, the unknown would have 1 unit of penicillin/ml. of serum. Inhibitions of the unknown above or below the seventh tube will be computed on the basis of the serial dilution principle. For example, if the eighth tube of the serum series shows inhibition, whereas the standard penicillin series shows inhibition through the seventh tube, the unknown would contain 2 units of penicillin/ml. But, if the unknown series shows inhibition through the sixth tube, the serum would contain 0.5 unit of penicillin/ml. The sample protocol in Table 1 illustrates the procedure.

TABLE 1

SERUM AND STANDARD SERIAL DILUTIONS FOR DETERMINING PENICILLIN BLOOD LEVELS

Serum Series								
Tube No.	1	2	3	4	5	6	7	8
Broth (ml.)	1.2	1	1	1	1	1	1	1
Serum (ml.)	0.8	.....	dilute serially	.....				
Culture, 1:100 (ml.)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Standard Penicillin Series								
Tube No.	1	2	3	4	5	6	7	8
Broth (ml.)	1.2	1	1	1	1	1	1	1
Penicillin solution, 1 unit/ml. (ml.)	0.8	.....	dilute serially	.....				
Culture, 1:100 (ml.)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

[1] The authors wish to express their appreciation to Mary A. Medill for her technical assistance.

Results. Using the technique described above, 30 human sera obtained from adult patients and normal subjects were tested for the presence of inhibitory substances against *Str. dysgalactiae*. Six bovine and two rabbit sera were tested also. No inhibition was demonstrated by any of the sera. In fact, the organism grew more luxuriantly in the tubes containing 1:2.5 serum dilution than in the tubes containing less or no serum.

TABLE 2

PENICILLIN BLOOD LEVELS OF PATIENTS RECEIVING PENICILLIN INTRAMUSCULARLY

(Test organism: *Streptococcus dysgalactiae*)

Patient	Dosage	Administration intervals	Blood levels		
			1 hr.	2 hr.	3 hr.
	Penicillin units	*Hr.*	*Penicillin units/ml. serum*		
1	20,000	3	0.25	0.06	0.016
2	30,000	3	0.13	0.03	0.016
3	40,000	3	0.13	0.016	
4	20,000	4	0.03	0	0
5	20,000	3	0.06	0.016	0
6	30,000	3	0.13	0.06	0.016
6	30,000	2	4.0*	2.0	
7	30,000	3	0.06	0	0
7	30,000	2	1.0	0.25	
8	30,000	2	0.25	0.25	

* This patient developed uremia with urinary retention.

This procedure was also applied in eight human hospitalized cases undergoing penicillin therapy. The results of the penicillin blood levels are shown in Table 2. Although the number of cases reported in this series is small, it will be seen from these results that, in the cases reported here, the penicillin blood levels are not therapeutically adequate when 20,000 units are given intramuscularly at three-hour intervals.

Summary. A strain of *Str. dysgalactiae* was found to be an effective test organism for penicillin blood-level determinations. This organism, although inhibited by penicillin in concentrations of 0.006–0.008 unit/ml., is resistant to the natural inhibiting substances of blood sera. The latter characteristic is very significant, since the test organisms (*Str. pyogenes* C-203 and *B. subtilis*) that are now employed for penicillin assay of body fluids are inhibited by a large percentage of human sera.

The method described can detect penicillin blood levels in concentration of 0.016 unit/ml. of blood sera. Since blood levels above 0.03 unit/ml. are considered to be therapeutically effective, this method of assay is adequately sensitive for routine clinical application.

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Letters to the Editor

Taxonomy and the Biologists

Carleton R. Ball's recent communication (*Science*, 1946, **103**, 713) states the grievances of the nontaxonomists so cleverly that they are apt to be accepted at full face value. These statements, however, are only partially valid. Systematists of today are not primarily interested in describing new species, or in erecting new names to replace old ones merely for the purpose of having their names attached to these supposedly new forms. Their primary motive is a sincere desire to place before the other workers in biology as full and complete a record of the forms living in the world as is possible with our present support and opportunities.

That he is doing as good a job in his field as the workers in any other field is a challenge that must stand until someone produces reliable statistics to the contrary. The mere listing of the mistakes made by the taxonomists will not override the challenge, because mistakes are made in all fields. The chief difference is that the taxonomist is the only worker who embalms his mistakes and erects them like totem poles along the highway, so that each succeeding generation of taxonomists must do obeisance as they pass by. Unfortunately no one has proposed a real remedy for this burdensome process.

Changes in generic names are due chiefly to five things: First is the fact that some earlier systematist has described the genus under another name. With the present survey of literature nearly complete, this cause for name-changing is almost a thing of the past. Second is the discovery that two authors have used the same name for two different organisms. With the recent publication of Neave's *Nomenclator Zoologicus*, most of the previous duplications can be cleared up. The number of duplications in the future should be small with such world-wide reviews of current literature as are now being published. The third cause of confusion is due to present and past methods of type selection. However, with strict enforcement of a rule which would prevent publication of new generic names without clear type designation, such confusion should be reduced to a minimum. Fourth is the division of a genus into two or more genera. This process has continued since the beginning

of binomial nomenclature, and we are apparently as far from the end of it as we are from its beginning. The fifth cause of confusion is due to misidentification of old genera and misinterpretation of previous descriptions. Changes in specific names are caused by all these mistakes except the third.

No one seems to have a very clear conception of the enormous number of species of animals living in the world today. An actual count of the number of genera and species of Homoptera in the card catalogue of this order of insects in my laboratory shows that there are approximately 3,100 genera and 30,000 species recorded. Perhaps from these counts of the number of species of Homoptera we may be able to get a real estimate of the number of species of animals that have been described. From various counts and estimates, I believe that the Homoptera represent from 1/100 to 1/150 of the Animal Kingdom. This would give us an estimated total of 2,500,000 species of animals, already described, of which 1,500,000 are insects.

There is, of course, no such thing as stable nomenclature—certainly not until the last organism is fully described, illustrated, and catalogued. The discovery of any new species or new genus is apt to upset all our present notions about phylogeny or evolutionary principles. How poor our present knowledge is of even fairly well-known groups needs no demonstration. Certainly stable nomenclature is a will-o'-the-wisp, no more to be desired than a stable chemistry or physics, embryology or morphology. Anyone who thinks that we must still continue in nomenclature on the basis of the names that he learned 40 years ago is thoroughly unscientific.

My earnest plea is for support for taxonomy from all biologists—not alone for financial support but also for a sympathetic understanding of its problems, limitations, and mistakes, and above all for a realization that all taxonomists are making a sincere effort to advance their branch of biology for the assistance of all biologists.

A colleague recently called my attention to this advice by Mephisto to the Student:

> Gebraucht der Zeit, sie geht so schnell von hinnen,
> Doch Ordnung lehrt Euch Zeit gewinnen.

Freely translated so that he who runs may read:

> Time flies so swiftly bye, use it,
> Only systematics can teach you, do not abuse it.

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Dormant and Adventitious Buds

An attempt is made here to distinguish more precisely between dormant and adventitious buds. It is probable, however, that an accurate nomenclature on the entire subject of buds will be possible only in the distant future.

Stone and Stone (*Science*, 1943, 98, 62) state: "It would be profitable to restrict the use of the term *dormant* or *latent* to buds formed in the axils of leaves (including scales) on the young annual shoots" and adventitious buds to those that "arise outside the normal phyllotaxy." They mention, however, that "adventitious buds, once formed, may also remain dormant."

I propose to classify buds as trace and adventitious buds. The concept of the dormant bud as a structure with a trace to the pith, and the capacity to remain dormant, is not valid, because buds in roots become dormant.

The trace bud has a trace to the pith and develops in the elongating region of the shoot. Primary trace buds develop in the axils of leaves. Secondary trace buds arise in axils of scales of other trace buds. A primary trace bud can become the ancestor of many secondary trace buds, with its trace branching and extending to them.

An adventitious bud lacks a trace to the pith and can appear wherever elongation has ceased. Adventitious buds can be found in roots, shoots, leaves, hypocotyls, epicotyls, and callus. They also develop in axils of scales of other adventitious buds and are connected by branching bud traces. Adventitious buds can be mistaken for trace buds when the traces begin near the pith.

Any bud can develop into a shoot, either immediately or after a quiescent period. With the terms dormant and quiescent having the same meaning, quiescent adventitious buds are dormant buds, and the distinctions between them disappear. There are merely trace and adventitious buds.

These distinctions, now made, are hereby projected into tree culture. Root suckers come only from adventitious buds. Sprouts arise from both trace and adventitious buds. Coppice consists of trees whose boles come from trace and adventitious buds and arise as sprouts and root suckers. It is not to be expected that all shoots from a stump develop from buds of the same kind and that their traces begin in tissues of the same age. If all buds on a stump are trace buds, no shoots arise below the root collar.

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Aseptic Cultivation of Excised Plant Embryos

The cultivation *in vitro* of excised embryos of seed plants presents certain practical difficulties, some of which have been only partially overcome. One of these difficulties has to do with the growing of embryos in solid medium in such a way as to prevent contamination, at the same time reducing to a minimum the rate of drying of the medium and the number of transfers required to maintain the cultures in a healthy condition.

We are using an extremely simple device to accomplish these ends. When embryos of *Oenothera* are large enough to be transferred from liquid to solid medium, they are placed in shell vials (70 × 21 mm.) containing a suitable amount of medium, and another sterilized shell vial (60 × 25 mm.) is inverted over the first vial, thus serving as a lid. No cotton plug or other material is used. Sufficient gas exchange to maintain health is permitted between container and lid, since the edges and bottoms of the vials are not absolutely flat. The container and its lid fit tightly enough together, however, to reduce evaporation to a minimum, thus allowing transfers to be maintained for long periods. In no case have we transferred oftener than once a month, and in some cases the interval has been as long as three months. Cul-

tures thus maintained have been brought to maturity with entire success.

This simple scheme was originally tried in an attempt to reduce the contamination which had been encountered where cotton plugs had been used. It was thought that a lid which would extend far down the sides of the container would put an end to contamination. Since adopting this procedure we have experienced practically no contamination in the shell vials beyond the rare infection introduced at the time of transfer.

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A Regrettable Error

While the editors of *Science* cannot be expected to assume responsibility for the errors made by contributors, it is a sad state of affairs when an article, coming from the physiological laboratory of a leading medical school, shows gross lack of understanding of the basic classification of the Animal Kingdom by elevating the Crustacea to phyletic rank (*Science*, 1946, **104**, 74).

Admittedly, scientific knowledge is becoming so complex that we cannot be expected to have the relatively full knowledge of a field and its related subjects that our grandfathers had, but it does not seem too much to ask that a student in any branch of biological science closely related to zoology should know, at least by name, the major phyla. It would appear from the context of the article that the author believes that there are other arthropods besides barnacles which are important fouling organisms. This is not the case, and such a sweeping reference to "other members of the phylum Crustacea" compounds the original error. Perhaps this does an injustice to the author in question, and the error was simply a *lapsus calami*. Nevertheless, it is an unhappy one.

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Potentiation of the Antibiotic Activity of Aspergillic Acid by Bismuth

It has been reported by the undersigned in a previous article (*J. lab. clin. Med.*, 1945, **30**, 899) that iron interfered with the antibiotic activity of aspergillic acid. It has also been shown that this interference was due to a complex formation between aspergillic acid and iron, the complex being inactive against bacteria.

While investigating the effect of other metals on the antibiotic activity of aspergillic acid, it was found that cobalt, nickel, zinc, arsenic, and bismuth caused a great increase in such activity. Of these, bismuth appeared to be the most effective when high dilutions of the various metals were used.

Bismuth, in a concentration which in itself caused no growth inhibition, decreased considerably the amount of aspergillic acid necessary for inhibiting completely the multiplication of *Staphylococcus aureus*. When human serum was added to the broth, the potentiating effect of bismuth decreased, although it was still demonstrable.

Table 1 represents the effect of bismuth and/or aspergillic acid on a fast-growing strain of *Mycobacterium tuberculosis*, using the cylinder plate method.

TABLE 1

Additions to cylinder	Diameter of circle of inhibition (mm.)
Aspergillic acid, 1 : 10,000	13
Bismuth, 1 : 50,000	0
Aspergillic acid, 1 : 10,000 and bismuth, 1 : 50,000	21

The mechanism of the potentiation of the antibiotic activity of aspergillic acid by bismuth cannot be explained satisfactorily at the present time. However, since bismuth is a sulfhydryl-group destroyer and aspergillic acid binds iron, it is reasonable to assume that certain bacteria are highly susceptible to the simultaneous interference with sulfhydryl groups and iron.

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Disease Control in Frogs

A leprosy-like condition is common in laboratory frogs of the four species, *Rana catesbiana*, *R. clamitans*, *R. palustris*, and *R. pipiens*. A brief description of the condition and means of prevention follows.

The initial external signs are minute ulcers on the toes, usually accompanied by the red spots of redleg. Soon the tissues begin to regress, the soft more rapidly than the hard, until bare bone protrudes. In extreme cases entire feet are lost, but more often death intervenes before more than parts of toes have disappeared. Accompanying the ulceration is a loss of function of afferent but not of efferent nerves. For example, there is no response by decapitated frogs to strong irritants applied to affected limbs, but those same limbs will make the appropriate motions to brush away irritants on unaffected parts of the body.

The disease is readily prevented by keeping the frogs in tap water to which 0.15 per cent NaCl has been added. Growth is normal and health good in this solution when the diet is adequate, e.g. meat, bone meal, and an added source of vitamin D. This diet and the salt solution have reduced deaths from all causes almost to zero. It is good practice to keep all laboratory frogs in the salt solution. We have had only four deaths in two years among hundreds of frogs.

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A Further Note on the Meaning of Normal

Several discussions have recently appeared on the meaning of normal (*Yale J. Biol. Med.*, 1945, **17**, 1493; *What people are*. Cambridge, Mass.: Harvard Univ. Press, 1945; *Science*, 1946, **104**, 87). All of these discussions

seem to have missed a rather important implication of the word "normal." Attention was called to this in a short, recently published note on physiological standards (*Fed. Proc.*, 1946, **5**, 61). It is too often the custom to refer tritely to physiological standards as "normal." This suggests presumptuous connotation of what ought to be. Such standards are merely averages or means of various observations on different, presumably healthy organisms. To refer to such averages as "normals" causes semantic and practical confusion. Physiological averages or means are scientifically descriptive. We are as yet in no position to attempt to agree on what physiological standards ought to be. Such an attempt, involving possible purposes, may be an ethical proposition, for which scientific descriptive data are necessary, but merely as one factor to be considered. Physiological standards may be established by appropriately scientific and descriptive methods. The normative approach to such standards is not yet appropriate.

It is important for scientists to remember that "normal" has a technical significance in ethics. It implies generally what "ought to be." This meaning is generally associated with the term, resulting in practical difficulties when scientists use the word "normal" to refer to a descriptive average. It is as important for scientists to be as precise in terminology as in measurement.

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Iron Concentrations in Cholinesterase Preparations

It is desired to call attention to the presence of iron in some cholinesterase preparations. Those who have available such preparations may wish to examine them for contained iron in order to reach a conclusion as to whether the metal is a contaminant or an intrinsic part of the enzyme.

On pharmacodynamic grounds it was postulated that cholinesterase was a heme compound (*Proc. Soc. exp. Biol. Med.*, 1943, **54**, 254). The arguments advanced for the heme nature of this enzyme would hold as well for the presence of a prosthetic nucleus containing any one of the transitional metal elements. The crucial argument is the marked antiesterase effect of fluoride ion which forms (usually) undissociated polar compounds with such elements.

Interest attaches, therefore, to the fact that crude cholinesterase preparations from three different sources have been found to contain iron in concentrations concomitant, if not proportional, to their esterase activity. A sample of electric eel material obtained from Dr. Howard M. Fitch, of New York University, 1 mg. of which hydrolyzed 1,200 mg. of acetylcholine per hour, had an iron content of 47.3 mg. per cent; a serum esterase preparation furnished by Dr. John H. Northrop, of the Rockefeller Institute for Medical Research, which split 20 mg. of acetylcholine per mg./hr., had 19.8 mg. per cent of iron; while a human erythrocyte cholinesterase prepared here, with an esterase activity of 7.8 mg. per mg./hr., had an iron content of 9.0 mg. per cent.

The iron contents of these esterase preparations are higher than have been found in esterase-free crude globulin concentrates, and this suggests that the iron either is concentrated along with the esterase fractions or comprises an actual component of the latter.

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Hypoparatypes

There has long been a general need for a recognized category for the "less typical" specimens which authors frequently use in arriving at their concept of a new species. Not infrequently certain specimens, although available to authors at the time of or prior to their proposal of species names, for various reasons are of such a nature that they cannot appropriately be named paratypes, with the implication that the latter name carries of being wholly adequate for subsequent comparisons by the same or other authorities. They are satisfactory neither as holotypes nor as paratypes; and at the present time these are practically the only terms in general use for the original series, at least in the field of vertebrate taxonomy. Yet it is only fair to the readers for whom the accounts are intended that all material be recorded. With recognition of an additional category, immature, injured, incomplete, or specially treated specimens might be listed without incurring the liability of their interpretation by others as "paratypic" material (in the above sense).

Accordingly, it is suggested herewith that specimens not wholly representative be regarded and listed as *hypoparatypes*. This term is defined as a category for specimens upon which an author originally bases his concept of the species newly named, but which are neither the single, select specimen (holotype) nor the other specially designated specimens (paratypes) serving as his chosen representatives of the presumed species.

The term suggested is a modification of *hypotype*, which might well be construed to have the same meaning as that proposed for hypoparatype. The former word has generally been applied, however, to subsequent, not concurrent, supplementary material; its use varies so considerably that substitution for hypoparatype would clearly court misunderstanding. No other term has been proposed, so far as I am aware, with the desired meaning.

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Rigid Thinking in the Social Sciences—A Vital Need

G. F. Hull has given us a most enlightening review of the development of physics in the United States (*Science*, 1946, **104**, 238). However, his sociological observations are hardly in line with the general excellence of his presentation.

"The scientists of this Nation," he asserts, "are not likely to make war on this or any other nation." It goes

without saying that neither will the physicians of this Nation, nor the teachers, nor, for that matter, the plumbers or the bartenders. Nevertheless, all of these were embroiled in the recent carnage, and the physicists were in the thick of the fight. Significantly enough, Dr. Hull's paper is preceded by a description of a gigantic naval research institution (p. 237) in which some 2,000 civilians, most of them scientists, will be sharpening the modern swords of war. When the bombs fall, scientists too, as well as their children, will die. As citizens, they cannot afford to assume a holier-than-thou attitude.

Dr. Hull also takes occasion to assert that the rulers of the country are "the so-called labor leaders, who, when the situation is right, make war on the rest of the Nation and who, at times of national emergency, hold up the Nation and demand its money or its life."

Now, anyone who, in the realm of physics, made a generalization so unwarranted and so oversimplified would be dismissed as one who had failed to assimilate the most elementary principles of scientific analysis. It cannot be repeated too often that the obvious need today is as rigid thinking in sociology as that which has been so fruitful in the physical and biological sciences.

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On the Question of Russian Scientists

Why the presumptuous agitation over the status of scientists in Russia—more specifically over the fate of a small number of individuals and more particularly Vavilov? The latest installment is that of P. J. Olson (*Science*, 1946, **103**, 656).

If scrutinized, our own record regarding political and social undesirables is far from savory. We have had abundant evidence that scientific endeavor is flourishing in Russia. For a recent report see the articles by Hastings and Shimkin (*Science*, 1946, **103**, 605, 637) and also that by Langmuir (*Chem. eng. News*, 1946, 24, 759). The treatment received by the latter in the helium liquifying laboratory of Kapitza compares rather to our discomfiture with that accorded by Bridgman, of Harvard, to visiting Soviet scientists (*Science*, 1939, 89, 179). Can it be that the Russians are more tolerant?

It is conceivable that foreign scientists contemplating migration to Russia could with propriety make detailed inquiries at to what their status there would be. The rest of us can well leave to the Russians their struggle to devise a tolerable existence. And so doing does not preclude friendly intercourse.

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Book Reviews

Electron and nuclear counters—theory and use. A. Korff. New York: D. Van Nostrand, 1946. Pp. vii + 212. (Illustrated.) $3.00.

This very timely treatise on the theory of the discharge mechanism and on the operation of various types of electron nuclear counters will prove a valuable reference book to all scientists engaged in pure or applied nuclear research and a necessary text for students preparing for research in these fields. Its importance is enhanced by current interest in the utilization of atomic energy in medical and biological problems, as well as in industrial and military developments.

During the last two decades counters have been developed as ionization chambers, proportional counters, and Geiger counters. But in general their behavior has been only vaguely understood and has proved perplexing to the majority of workers, partly because no single text has heretofore existed giving a complete and systematically presented theory of their operation. Consequently, Prof. Korff's masterly presentation of practically all phases of counter operation promises to be the handbook which will clarify the operational problems of counter technicians.

The author introduces his subject through a summary of the development of counters, a description of current uses, definitions of terms, and a general description of the phenomena involved. The unique behavior of counters in the low-voltage region, in the proportional region, and in the Geiger region is clearly defined, and the types of counters used in these separate regions are treated according to their distinct characteristics.

The characteristics of counters currently employed for measuring the intensity of radiations—X-rays, gamma rays, and cosmic rays, for counting the charged particles and neutrons, both fast and slow, which are emitted in atomic transmutations and disintegrations, for the detection of radioactive deposits by the geophysicist or radioactive tracers by the biophysicist, or for the measurement of dosage in radium therapy are discussed in the text with ample detail. Included are characteristic curves for the various counters, discussions of self-quenching and non-self-quenching counters with explanations of pulse size and effects of negative ions, as well as directions for the construction of counters and of the auxiliary electronic circuits.

Particularly valuable are the numerous circuit diagrams and the discussion of the vacuum tubes employed for quenching, coincidence, scaling, and recording cir-

cuits, as well as integrating circuits and pulse amplifiers. Frequent references are made to the literature, and the final contribution is a generous bibliography on counter construction and practice.

The clarity and inclusiveness of all these discussions will be welcomed by the large body of scientific and technical workers who constantly or even occasionally employ this increasingly valuable tool.

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The effect of smallpox on the destiny of the Amerindian. E. Wagner Stearn and Allen E. Stearn. Boston, Mass.: Bruce Humphries, 1945. Pp. 153. $2.50.

Introduced to the New World shortly after Columbus' discovery, smallpox decimated the native population for four centuries, constituting one of the most important factors in the displacement of the American Indian by the Whites. It has been estimated that between the years 1500 and 1850 at least 3,000,000 Indians died from smallpox in the West Indies and in Central and South America. The authors of the present volume give an account of its ravages north of Mexico, where the disease claimed approximately an additional 500,000 lives of an aboriginal population of 1,150,000. The role disease plays in the history of populations cannot be overemphasized and constitutes an approach that has not received the attention it merits. The effect of smallpox was devastating on the American Indian not only in the often complete extermination of whole villages and tribes but also in the spreading of terror, the breaking of morale, and the disintegration of native cultures.

In a well-documented account the spread of smallpox is traced from tribe to tribe. It is shown that epidemics appeared in cycles and that the death rate varied, depending on the virulence of the virus, the type of smallpox, and how much care the sick received. Recurrence of high death rates depends on the growing up of nonimmune populations. With the exception of a statement in which the American Indians are referred to as a "highly susceptible, non-immune race" (p. 8), the authors make it clear throughout the book that, strictly speaking, there is no such thing as "racial immunity." Early attempts to prevent infection were generally unavailing and in many instances met with strong resistance. Control came about gradually at first (1721) through variolation, after 1797 through vaccination, until in 1905 smallpox ceased to be a menace to the Indian.

Necessary corrections are few and of only a minor nature. The population figures for the American Indian are based on the estimates of Mooney, which are the most reliable in existence. A revision of these figures is available only for California.

The authors are to be commended on having made a valuable contribution both to the history of medicine and to anthropological demography in this well-documented and readable reference work.

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Theory and practice of filtration. George D. Dickey and Charles L. Bryden. New York: Reinhold, 1946. Pp. v + 346. (Illustrated.) $6.00.

In this new book the co-authors of the older volume, *A textbook of filtration*, have greatly expanded the scope of the work with the introduction of much new subject matter. A brief history of filtration is followed by a comprehensive discussion of the objectives, the media, the apparatus and machinery, and many of the applications of filtration as a unit operation. In its description of filters and filter presses of all kinds and the mechanics of their operation the book is undoubtedly all that could be desired, except perhaps that, in spite of a prefatory promise, operating data on which to base plant equipment design are somewhat meager.

It is rather in the matter of filtration theory that the work falls short of meeting the implications of its title. The mathematics of the subject, such as it is, is touched lightly indeed, and the chemistry and physics of colloidal suspensions are ignored. Surely the plant engineer bedeviled with the problem of filtering a gelatinous slime would find little in this volume to comfort his misery. By the same token a history of filtration should at least mention the blood, sweat, and tears shed in developing the art of activated sludge filtration in Milwaukee in the early 1920's.

Lest the reviewer's stand be misconstrued, it should be said that filtration practice ranges on the one hand from the dewatering of granular suspensions that present no difficulty to the pretreatment and dehydration of complex slimes on the other; only the science of colloids can give much help to the solution of problems in this latter and more important phase of the subject. If the reviewer were allowed to compromise on a title such as *The practice of filtration*, he would in all sincerity call this a fine book.

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Human embryology. Bradley M. Patten. Philadelphia-Toronto: Blakiston, 1946. Pp. xv + 776. (Illustrated.) $7.00.

Teachers of embryology in medical schools will welcome this volume on the development of the human embryo as an addition to the literature of this special field. The emphasis on the incompleteness of our knowledge, which necessitates a changing viewpoint as more information is acquired, holds before the student the too easily forgotten idea that science cannot be learned "once for all time."

The excellent illustrations of progressive stages of histogenesis in different organs help to bridge the gap between the thin line of cells representing the organ in the embryo and the adult tissues as studied in histology. The inclusion of some gross dissections of the adult body is an excellent idea, since the steps taken by the fetus in development are better understood when the goal to be attained is clearly defined. The three stages in the descent of the testis and the schematic

diagram of the inner ear are cases in point. The liberal use of color in the illustrations is of great value in complicated diagrams. A more satisfactory result would have been achieved, however, if certain of the diagrams had been enlarged to cover two pages instead of one. A table giving a bird's-eye view of the stage reached by the various systems at different fetal lengths and fertilization ages would have been of value for students trying to place the approximate age of any given embryo. It is gratifying to see included a table of mean weights of organs corresponding to different fetal weights. An additional feature of great value here would have been the range of these weights, the standard deviations, or both. It is to be hoped that these will be included in the next edition.

This is a book dealing with the human embryo, and the comparative details of cleavage, germ layer, and membrane formation in lower forms have been omitted with resultant clarification of presentation. The student must study the young embryo as a unit rather than as a series of body systems; hence, the chapter which takes the reader through the early phases of development in all the systems is an excellent one. The general topics of gametogenesis, changes in the maternal organs in preparation for fertilization and implantation, membrane formation, early development of the embryo, age and growth changes in external appearance, twins and teratology are all discussed before the "system by system" description is dealt with. Then follows an account of development in the integumentary, connective tissue and skeletal, muscular, and nervous systems, sense organs, face and teeth, digestive and respiratory systems, coelom and mesenteries, ductless glands, pharyngeal derivatives, urogenital and circulatory systems.

An excellent bibliography of 42 pages, arranged according to chapters, and an index in which pages with illustrations are set in boldface type complete a highly satisfactory text on human development which should stimulate makers of medical curricula to recognize this as a science in its own right, not as a mere adjunct of gross anatomy.

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Diseases of the retina. **Herman Elwyn. Philadelphia-Toronto: Blakiston, 1946. Pp. xi + 587. (Illustrated.) $10.00.**

The comprehensive exposition of retinopathy as primary eye disease and as secondary eye changes developed in the course of chronic systemic disease is presented for the use of physicians in this most recent book by Elwyn. When one considers the importance of vascular changes in the body during growth, development, anatomical disorders, and disease—changes that for the most part must be inferred by indirect means—the value of ophthalmoscopy is incalculable. Only in the fundus of the eye can the blood vessels be clearly seen, greatly magnified, in their natural state. The vascular networks of the retina and choroid constitute the most important feature of the fundus picture, since they not only undergo changes due to aging and diseases of the vascular system but are subject to wear and tear of circulatory effects of general systemic and local diseases such as arteriosclerosis, hypertension, and many of the blood dyscrasias.

In 1871 Clifford Albutt published a book on the ophthalmoscope, much of which was devoted to vascular changes and their sequelae in the fundus. The ophthalmoscopic picture of Bright's disease and other disorders of the kidneys, of diabetes, of uremia, and of many conditions which effect the general circulatory mechanism, was meticulously described and commented on by a general practitioner rather than an ophthalmologist.

Since that time many volumes have appeared on cardiovascular-renal disease. The nature of the changes in the blood vessels themselves and the resultant changes in organs with various types of blood supply, particularly the kidney, have been studied, and of the results of these studies new explanations have frequently been offered. It is hardly conceivable that a book on disease of the retina could be published that would give in detail the various conceptions of retinal manifestations of vascular disease. Ophthalmologic studies have contributed a great deal to the fund of knowledge that has been built up about vascular and related diseases. The cooperation that has existed between ophthalmologists and internists has made possible a good understanding of certain eye diseases that would otherwise have been hazy in the minds of most of us.

It is no accident that the author opens his book with an account of retinopathy resulting from disturbances in circulation and from vascular malformations. Together they constitute the largest of the sections. In 170 pages he describes the pathological changes as well as the clinical appearance and adds, where possible, an explanation of physiological processes. The current conceptions of the significance of ophthalmoscopically visible retinal changes are stated clearly and understandingly. They may not always be the explanations most acceptable to the reader, but they are historically correct, reasonable, and only slightly controversial, as he has wisely omitted arguments to sustain his theme. The most difficult of all ophthalmological subjects to write upon at the present time has been presented in a most useful manner for the understanding and use of all persons interested in ophthalmology and in the retinal changes in circulatory disease.

In seven chapters, or parts, the diseases of the retina on a hereditary basis, inflammatory diseases of the retina, tumors of the retina, diseases of the retina leading to retinal detachment, developmental anomalies of the retina, and radiation injuries of the retina are described briefly, with comment on the systemic relationship, pathology, and treatment. These have to do mostly with conditions that concern the ophthalmologist. The classification of ocular diseases is based on physical and pathological findings adequate for the needs of clinicians. The work is comprehensive enough to be a valuable handbook on diagnosis.

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